IMPERIAL
DEPARTMENT OF AGRICULTURE
FOR THE WEST INDIES.

REPORT

ON THE

AGRICULTURAL DEPARTMENT, DOMINICA.

1913-14.

BARBADOS:
ISSUED BY THE IMPERIAL COMMISSIONER OF AGRICULTURE
FOR THE WEST INDIES.

1914.

[Price Sixpence.]

REPORTS

ON THE

BOTANIC STATION, ECONOMIC PLOTS AND AGRICULTURAL EDUCATION, DOMINICA.

Annual Reports on Certain Economic Experiments conducted in connexion with the Botanic Station, 1900-2.

Annual Reports on the Botanic Station for the years 1901 and 1902.

Annual Reports on the Botanic Station, Economic Experiments and Agricultural Education for the years 1902-13.

SUGAR-CANE EXPERIMENTS.

IN BARBADOS.

Report of the Agricultural Work for 1900 :—
Manurial Experiments and Experiments with Varieties of Sugar-cane.

Report of the Agricultural Work for the seasons 1899-1901 to 1908-10.
Parts I and II ; Manurial Experiments. Part III ; Varieties of Sugar-cane.

IN THE LEEWARD ISLANDS.

Report on Experiments conducted with Sugar-canes in the season 1899-1900.

Reports on Experiments conducted with Sugar-canes in the seasons 1900-1 to 1909-10.

Part I ; Varieties of Sugar-cane. Part II ; Manurial Experiments.

Sugar-cane Experiments in the Leeward Islands, 1911-12 and 1912-13.

Parts I and II published together in Royal 8vo.

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CONTENTS.

PAGE.

Work in the Gardens and Observations on Plants 1

Observations on Plants—Plants recently flowered—Recent Additions to the Collection

Work in the Nurseries and Distribution of Plants 3

Plant Distribution—Plant Importations

Plot Experiments at the Botanic Station 6

Notes on Economic Plants 6

Quarterly Tapping of Castilloa—Investigations with Grasses—The Budding of Cacao

Work Connected with Insect and Fungus Pests 12

Pests of Oranges—New Fungus on Lime Leaves

Progress in the Chief Industries 14

Lime Industry—General Conditions—Raw Lime Juice—Citrate of Lime—Fresh Limes—Lime Oils—Cacao—Coco-nuts—Minor Products

Efforts in Connexion with General Agricultural Progress ... 19

Preparation of Lime Products—Testing of Lime Juice—Examination of Lime Oils for Adulterants

Extension of Interest in Agricultural Matters 20

Permanent Exhibition Committee—Victoria Museum

Details of Administration 22

Expenditure, etc.—Staff Changes—Repairs to Buildings, etc.—Correspondence, etc.—Visits to Estates—Official Visits to the Station—Miscellaneous Notes—Experiments with Dynamite—Plant Exchanges—Meteorological Returns

Manurial Experiments with Lime Cultivation 29

Agricultural Education in Dominica 31

Instruction at the Botanic Station—Training of Pupils—Number of Pupils—Field Work—Class Work—External Examinations—Cadet System—Prize-Holdings Competition—List of Prize Winners—Reading Courses—Science Teaching at the Grammar School

Cacao Experiment Plots: Manurial Trials 40

Original Series—Yields—Hillsides Plots—Yields—Discussion of Yields—Quarter-acre Plots—Mean Results—Table of Yields—Additional Plots—Grafted Cacao—Yields of Other Crops in the Gardens

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LETTER OF TRANSMITTAL.

Commissioner of Agriculture—to His Honour the Administrator, Dominica.

No. D. 2336. Barbados,

August 11, 1914.

Sir,

I have the honour to forward the Report on the Agricultural Department, Dominica, for the year ending March 31, 1914.

2. In issuing this Report certain improvements in the form have been introduced, namely, general headings immediately under the number of each page, and a table of contents on the first page. This should facilitate reference considerably.

3. Of the more important sections in the report may be mentioned those dealing with progress in the chief industries, the section dealing with the propagation of cacao and the appendix containing information on lime and cacao manurial experiments and also on agricultural education in Dominica.

4. The lime crop continues to expand both in yields and export. The value of the lime products shipped during 1913 was £45,989 above that for the preceding year and amounted in all to £142,662. This favourable state of development fully justifies the experimental work with lime cultivation that has recently been inaugurated.

5. The establishment of an Experiment Station devoted to the study of problems connected with limes is a matter of great interest: knowledge concerning limes and lime products is scanty and it is expected that this Experiment Station will have the effect of adding considerably to the information available, as the work connected with cacao at the Botanic Station has already done.

6. In regard to cacao, Mr. Jones' views on propagation deserve the careful consideration of planters and it may be agreed that budding both of cacao and off limes possesses many advantages over other forms of propagation and should continue to receive attention experimentally with a view to devising methods in this connexion suited to estate practice.

7. The system of agricultural education in Dominica is now in a condition of great efficiency serving, as it does, the requirements of all the various sections of the agricultural community.

8. I have pleasure in stating my appreciation of the good work that has been done by the Agricultural Department during the year under review, and feel confident that the large amount of valuable information which this report contains will be appreciated by all those who are interested in Dominica and its industries.

I have, etc.,

(Sgd.) FRANCIS WATTS,

Commissioner of Agriculture
for the West Indies.

REPORT ON THE AGRICULTURAL DEPARTMENT, DOMINICA,

For the Year ended March 31, 1914.

Work in the Gardens and Observations on Plants.

The area of the Botanic Gardens is 42 acres, over half of which is devoted to experiment plots; the remainder having been laid down in lawns and planted with useful and interesting trees and plants in order to form a park for the inhabitants of Roseau. In the early days it was possible to carry on the whole of the departmental work within the limits of the Gardens. As the work developed, a piece of Government land near to the Roseau River, and separated from the Gardens by the public road had to be utilized for a nursery. Later additional nurseries and experiment plots extending over several acres were started at Morne Bruce. During the past year, sixteen manurial experiment plots with limes, of an area of ¼-acre each, were commenced in the valley lying to the South of Morne Bruce. Authority to start six additional plots was given towards the close of the year, and a few more may be necessary to make a complete series of experiments with lime cultivation. The land now worked by the Department is about 60 acres in area, with the prospect of further additions in the near future.

It would be of the utmost value to the Department if the valley lands lying to the south of Morne Bruce could be constituted an experiment station with an annual vote for upkeep. The area of the higher part of the valley is about 25 acres, of which from 16 to 18 acres are suitable for cultivation. At present the area under manurial experiments with limes in the valley is 6 acres and further developments may increase this to about 10 acres. The money at present voted is for lime cultivation only. Experiments with other valuable economic plants are needed, but these cannot be started until an experiment station is authorized. Although experiments of this character cannot be expected to pay in cash value, still the receipts from the several acres of lime trees now in the course of being established may be expected to form a considerable contribution towards the cost of upkeep.

The formation of an experiment station would be the natural corollary of the successful work at the Botanic Gardens during the past twenty years, in which period a large and valuable collection of specimens has been brought together.

At the present time a number of these interesting economic plants are commencing to fruit. In many cases it is highly desirable to form small plots of particular trees in order to test fully the suitability of the species to the climatic conditions, and for the purpose of supplying sufficient material for propagation should a demand for seeds and plants arise. Owing to the Gardens tending to become congested it is not possible to continue to meet the demands for space, the lack of which must arrest the development of this line of experimentation. The commencement of an experiment station on Government land would remove this difficulty and enable the propagation of new plants to proceed, some of which may be expected to prove of great value in assisting in the economic development of the island in the future.

It is satisfactory to be able to report that steady progress has been made in the various lines of departmental work during 1913. The rainfall during 1912 was again below the average, a favourable feature in the wet climate of Dominica; and high winds, which sometimes cause considerable damage to plants, were not experienced during the hurricane season.

A specimen of the Moreton Bay Chestnut, *Castanospermum australe*, about twenty years old, flowered and fruited in the Gardens for the first time. The tree, which belongs to the Natural Order Leguminosae, possesses handsome foliage and produces pea-like flowers of an orange colour. The flowering and fruiting of this tree in Dominica is a matter of botanical interest only. The fruit despite its name, is of little value. It is stated in the 'Treasury of Botany', that although the fruit has been extolled and placed upon an equality with our chestnuts, they are in reality not much superior to acorns, and have an astringent taste; they are improved by roasting and no doubt proved acceptable to the travellers who first visited Moreton Bay.

Another papilionaceous tree in the Dominica Gardens which has made a brilliant display of flowers lasting over a period of several weeks, is the Dhak tree of India, *Butea frondosa*. The 'Treasury of Botany' states: 'when in full flower the Dhak tree is a gorgeous sight, the masses of flowers resembling sheets of flame, their orange red petals contrasting brilliantly against the jet black velvety calyx.' The tree, which yields Bengal Kino, is of considerable economic importance to the natives of India.

During the dry season, excellent displays were made by the fine flowering trees, *Cassia grandis* and *Cassia nodosa*. Both these trees might be widely grown in the West Indies on account of the beauty of their flowers and the considerable period—over six weeks—during which they remain in blossom. Under good conditions the trees commence to flower when about three or four years old.

A plant of *Camoensia maxima*, received from the Botanic Gardens, Trinidad, a few years ago, flowered for the first time. Although this is a very fine leguminous climber from tropical Africa, its flowers, about which so much has been written in the horticultural press, cannot be said to equal, either in size or beauty, those of *Baikiaea insignis*, a leguminous tree from West Africa, which has successfully flowered in Dominica for several years past.

During May a rooted cutting of *Spachea perforata* was received from the Botanic Gardens, St. Vincent, and is now growing nicely. This is an interesting species of which the old tree at St. Vincent is the only specimen known to botanists.

Correspondence with the authorities at the Royal Gardens, Kew, has led to the identification of a leguminous tree very common along the banks of the Indian River at Portsmouth, and also occurring along the rivers and streams in the northern district of the island.

In acknowledging the receipt of herbarium specimens of the leaves and flowers, the Assistant Director wrote as follows:—

'The tree proves to be *Pterocarpus officinalis*, Jacquin (*P. draco*, Linn.).

'The names *P. draco*, Linn., and *P. officinalis*, Jacq., were published in the same year. Linnaeus' species, however, was a mixture of the West Indian and Indian plants whilst Jacquin's referred only to the West Indian plant.

'Urban has accepted Jacquin's name *P. officinalis* in preference to *P. draco* for the West Indian plant and the Indian River trees should therefore be known under the name of *Pterocarpus officinalis*.'

The following note on the uses of this tree has been furnished by the Hon. J. C Mcintyre:—

'The tree is known locally as Mangrove, the patois name being Pallativier. It grows plentifully in marshy land, and along the borders of streams, in the northern and eastern sides of the island. There are also a few trees on the west coast at Salisbury. The wood burns readily even when green and produces a pure white ash. It is much used for burning lime. The bark contains a resin of a rich red colour from which wood-stain is sometimes prepared: in some of the islands it is said to be used for staining floors. The buttressed roots which are very tough when dry are occasionally used by the natives for making wheels for cocoa drying trays and also for making decoys for turtle nets. The wood is of no value as timber.

The tree is confined to the sea-board. I have never seen it growing more than about half a mile inland.

A Wardian case and one box of plants were received from the Royal Botanic Gardens, Kew, in October. The contents added many new and interesting plants to the Garden collection.

Sixty-four iron labels giving the names and habitats of plants recently established in the Gardens were received from England and placed out.

The following have flowered in the Gardens for the first time :—

Mimosa acle (=Xylia dolabriformis.)
Camoensia maxima.
Canarium commune.
Mangifera sylvatica.
Strophanthus Preussii.
Brexia madagascariensis.

The following are amongst the interesting plants added to the collection during the year :—

Spachea perforata.
Hernandia sonora.
Songamia glabra.
Bauhinia variegata.
Piptadenia perigrina.
Pavetta caffra.
Alpinia Sanderi.
Limonia Pogga, var. latialata.
Brownea Kewensis.
Dichopsis Gutta.
Parkia timoriana.
Schleichera trijuga.
Juniperus pachyphloea.
Kokia Rockii.
Pterocarpus Rohrii.
Pterocarpus officinalis.

Work in the Nurseries and Distribution of Plants.

In the *Agricultural News*, No. 285 page 100, reference is made in an article to a stock used in Morocco for oranges, which is resistant to foot disease. It is known by the name of 'M'gergeb'. Stress is laid on the fact that it is easily propagated by slips and that varieties budded on it fruit early.

Through the good offices of the Director of the Royal Gardens, Kew, the Commissioner of Agriculture was able to obtain six small plants. These arrived in Dominica in October and were at once planted out and tended carefully. Propagation of the stock by cuttings will first receive attention, after which experiments in budding will be made.

Judging by the appearance of the plants, the new stock is closely related to the Citron. It appears to be a free grower and will probably prove very easy to bud. Whether it will take the place of the sour orange stock in wet districts in Dominica is doubtful, but it may prove to be a useful stock for oranges and grape fruits when these are intended to be grown on light soils near to the Leeward coast.

In the Annual Report for 1909-10 and in the *Agricultural News*, No. 223, page 356, particulars are given of an experiment in importing by post budwood of five varieties of grape fruit from Florida. The budwood arrived in June 1910 and was

at once worked on sour orange stocks. Thirty-six per cent. of the buds grew, a satisfactory result when consideration is given to the time—in this case three weeks—during which the budwood was in transit. Three and a half years later single specimens of the varieties Marsh's Seedless, Pernambuco and Manville's Improved had ripened their first crops in the Gardens. The first-named in this instance proved the most prolific, having yielded 8 dozen fruits; while the specimens of Pernambuco and Manville's improved bore 5 and 2 dozen fruits respectively.

The experiment was repeated during December 1913 when budwood of the varieties Ducan, Walters and Hall's Silver Cluster grape fruit was imported from the Glen St. Mary Nurseries, Florida. In this case the budwood was posted on November 29 and arrived in Dominica on December 23, on which date twenty buds of each kind were inserted in a corresponding number of sour orange stocks. The results of this experiment are given below:—

	Buds inserted.	Buds which grew.	Percentage.
Silver Cluster ...	20	20	100
Ducan	20	19	95
Walters	20	11	55

There can be no doubt that the best way of introducing varieties of citrus is by means of budwood. The old system of importing plants had many drawbacks. Often the plants were budded on stocks which were found to be unsuited to West Indian conditions, and this fact led to loss and disappointment. In addition the system of introducing plants was cumbrous and expensive. Introduction of new varieties by means of budwood is reliable and cheap. In the present instance the cost of the budwood was 90 c.; postage 72 c.; total $1·62. The result is the possession of 50 budded plants, on stocks known to be suited to local conditions, and valued at $12·00.

Plant distribution was not on quite so large a scale as formerly though the number sent out makes a respectable total. A table of the plants distributed is given below:—

Limes	54,543
Budded Washington Navel orange	96
,, Grape fruit	353
,, spineless limes	20
,, tangerines	8
Grafted mangoes	19
Cacao	565
Para rubber	1,522
Vanilla	600
Eucalyptus	90
Shade trees	60
Nutmegs	124
Camphor	8
Miscellaneous	190
Total	58,198

The following quantities of seed were sold:—

Vegetable	1,089 pkts.

Quantities of seeds of various green dressings and of the lime and Congo coffee were distributed to planters free of charge.

PLANT IMPORTATIONS.

Attempts to establish plants of the Sapucaia Nut, (*Lecythis Zabucajo*), have not proved entirely successful. Only those which are planted in the open and fully exposed to the sunlight have remained healthy and made some little growth. Those planted in shady places have died. Apparently this tree requires full sunlight even when in the nursery stage.

The specimens of *Aleurites Fordii*, mentioned in last year's progress report as being one of the sources of the Tung or Wood oil of China, have made but little progress Only two of the specimens look healthy. This species thrives best in its habitat on dry rocky hillsides, therefore it is probable that the climatic conditions of Dominica are unsuitable. Further trials will be made with this plant. An allied species, *Aleurites triloba*, the seeds of which are said to yield a similar oil, is already established in Dominica. In this case the trees always attain a large size in districts where the rainfall is considerable. On the coast with a low rainfall the trees are small in size. It flowers freely, but little appears to be known about its fruiting capabilities.

The Shea Butter tree, *Butyrospermum Parkii*, introduced from Kew fourteen years ago, produced a small crop of 150 fruits. Attempts to raise plants have not been very successful and it is evident, in order to secure a good rate of germination, that special treatment of the seeds is necessary. It has been noted that seeds laid upon the soil gave better results than those covered with soil.

In the early stages the seedlings are extremely delicate, and require great care.

In this connexion it has been stated by His Excellency Sir H. H. Bell, K.C.M.G., Governor of the Leeward Islands, and formerly Governor of Northern Nigeria, that in districts in Tropical Africa, where the tree is native, old specimens only are met with, and that it is very rare indeed to see a young tree. This is remarkable, as the tree is of great economic value. Possibly there may be difficulties in the way of raising this plant even in its native country.

Seeds of *Barosma betulina* and *B. serratifolia*, two South African plants, were received from the Commissioner of Agriculture in July, but no success attended the efforts to germinate them.

The plants named are the source of Buchu leaves, used largely in medicine, and for which, during recent years, there is a steady increasing demand.

During May seeds of the interesting *Kokia Rockii*, a species closely related to the cultivated cotton plant, were received from the United States Department of Agriculture. This species occurs in nature in one place only in the Hawaiian Islands. As there is some danger of the plant becoming extinct, efforts have been made by the above-named Department to obtain seeds for distribution to Botanic Gardens throughout the Tropics with a view to its establishment in various places.

A few plants have been raised from the seeds sent to Dominica. These will be reported on in due course.

The *Kew Bulletin* recently drew attention to the value of the stems of *Hedychium coronarium* as a source of material for paper making.

Rhizomes of the above-named plant were received from Kew during May and it proved, as expected, to be identical with the Ginger lily, a plant very common along the banks of streams in certain parts of the island.

Paper made from this material has been found to possess exceptional strength, as well as other good qualities.

A single specimen of the Gutta Percha tree, *Dichopsis Gutta*, was received from Kew in October. It is hoped to establish successfully this interesting and rare species.

Plot Experiments at the Botanic and Experiment Stations.

GREEN DRESSING TRIALS IN DOMINICA.

There are four species which appear to be particularly suited for growing as green dressings under the conditions prevailing in Dominica, viz., the horse bean (*Canavilia ensiformis*) the pigeon pea (*Cajanus indicus*) and the two species of Tephrosias – candida and purpurea. Plots of these four plants are maintained at the Station and seeds are available for distribution at the proper season.

The horse bean is well known and is particularly useful when the ground is only available for a short time between two crops. It requires to be replanted every four or five months. The seeds are large and germinate readily.

The pigeon pea is equally well known and may be used with advantage in heavy retentive soils. It has been very successfully used under these conditions between young coco-nut plants in a plot of the latter at the Station, the coco-nuts making quite satisfactory growth. The seeds germinate well and there is not much difficulty in getting a good stand.

Both Tephrosias are recently introduced species and a detailed account of their habit of growth, etc., appeared for the first time in the annual progress report for 1911-12. It was there stated that the seeds of *Tephrosia candida* did not germinate freely. As the plant became acclimatized, however, fertile seeds were produced and there is now no difficulty in this respect. *Tephrosia purpurea* produces fertile seeds abundantly.

Both these plants may be considered to be very valuable additions to the few really good plants available for this purpose. They form a dense shade over the ground, keeping it free from weeds for many months. The seeds, however, are small and need careful planting in well prepared soil ; they also require at least two weedings in the early stages of their growth.

Notes on Economic Plants.

CASTILLOA ELASTICA.

The quarterly tapping of a number of Castilloa rubber trees was commenced in April 1911, and continued without a break up to April 1914—a period of three years and including twelve quarterly tappings.

A detailed account of the methods of tapping and of preparing the rubber from the latex appeared in the *West Indian Bulletin*, Vol. XIII, No. 3. It may be mentioned here that the tapping was thoroughly performed under careful supervision and care taken to lose none of the latex.

The yields obtained and other particulars are given in the table below. From this it will be observed that Castilloa rubber trees when subjected to systematic tapping once every quarter fail to yield remunerative returns. For this reason this species of rubber-producing plant cannot be recommended for extensive cultivation in Dominica.

Having completed three years of quarterly tappings it is now intended to tap the trees twice a year, in June and January—the two months during which the tree were found to give the greatest yield.

TAPPING EXPERIMENTS WITH CASTILLOA ELASTICA, 1911-14.

No. of trees tapped.	Age. Years. 1914.	Average girth 3 feet from ground.						Actual yield of rubber in four quarterly tappings.			Yield per tree per annum.			Mean annual yield per tree over three years.	
		1911-12.		1912-13.		1913-14.		1911-12.	1912-13.	1913-14.	1911-12.	1912-13.	1913-14.		
		ft.	ins.	ft.	ins.	ft.	ins.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb. oz.	lb.	oz.
4	22	7	1	7	6½	7	9	5 11	2 11	1 9½	1 7	0 10¾	0 6 4	0	13·2
9	15	3	1	3	1½	3	5¾	1 8	0 8½	0 9¾	0 2·7	0 1	0 1	0	1·5
37	14	3	0	3	2	3	1	7 10½	2 8	1 11	0 3·3	0 1·1	0 ·07	0	1·7

Dominica Grasses.

In May of 1913, the Imperial Commissioner of Agriculture suggested that a collection of specimens of the grasses in Dominica should be prepared and forwarded for their identification to Mr. A. S. Hitchcock, Systematic Agrostologist of the United States Department of Agriculture, who is studying West Indian grasses.

The Assistant Curator undertook this work as time permitted, and up to the present forty-one species of Dominica grasses have been identified.

At the same time notes were made as to the locality found, local name, and as far as possible as to the feeding value of the different grasses. It is hoped to publish the results of this investigation at a later date.

Mr. Hitchcock, to whom this Department is much indebted, has named the following of the Dominica grasses —

List of Dominica Grasses collected during 1913-14.

Andropogon condensatus
" brevifolius
Anthephora hermaphrodita
Axonopus compressus
Boutiloua americana
Capriola dactylon
Cenchrus viridus
Chaetochloa glauca
Chloris radiata
" paraguayensis
Dactyloctenium aegyptium
Echinochlora colonum
Eleusine indica
Eragrostis ciliaris
" tephrosanthes
" delicatula
Eriochloa punctata
Isachne disperma
Ischaemum latifolium
Lasiacis, n. sp
Leptochloa virgata
Oplismenus coliaceus
" hirtellus
Panicum pilasum
" laxum
" maximum
" trichoides
" barbinode
" (chaetochloa) barbatum
Paspalum conjugatum
" virgatum
" fimbriatum
" paniculatum
" pumilum
" Helleri
Pennisetum setosum
Setaria brachiata
Sporobolus jacquemontii
Stenotaphrum secundatum
Syntherioma digitata
Valota insularis.

The Budding of Cacao.

Since the notes on the grafting of cacao were published in pamphlet form, experiments in the budding of cacao stocks growing in bamboo pots have been made and a certain measure of success has been achieved.

A means of successfully budding cacao has long been desired chiefly on account of certain inconveniences inseparable from grafting by approach, which added to the expense of producing plants though the method itself, apart from the time occupied and field work involved, is, with care, easy to carry on and successful in results.

The budding of stocks has several advantages over grafting by approach, chief amongst which are the centralization of the work in nurseries, and the fact that a selected tree capable of yielding several hundred shoots for inarching during a season, would, in the same time, yield thousands of buds, thus rendering the propagation of a given variety much more speedy than is at present possible by inarching.

The stocks used were of the hardy Calabacillo variety, the seeds being sown in boxes and transferred to bamboo pots when a few months old. Once established in the latter, and when in good health and growing condition, budding was attempted which resulted in success.

The method which yielded the highest percentage of successes was the well-known system of patch-budding.

In this form of budding a portion of the bark is removed from the stock and a similar piece with an eye is carefully fitted in its place. When in position, the bud is tied with raffia and then wrapped with budding tape in order to protect the scion and to exclude air and moisture. In about ten days the bud may be examined, and if signs of union are observed, the tying may be cut or loosened, and the tape again wrapped loosely around the stem as a protection for a few days longer until the bud can be exposed. With careful treatment growth should soon commence. When the young shoots have attained a length of from 6 to 8 inches and become hardened, the upper part of the stock may be removed.

In the case of cacao it would not appear desirable to turn down the head of the stock at the time of budding.

Experiments with the ordinary shield or inverted T budding, a method extensively used for propagating citrus plants, have yielded poor results It is unlikely that this system will be successful to any degree in the case of cacao. Patch budding or some modification of this method would appear likely to yield the best results.

It is important to note that if success is to be achieved great care is needed at every stage of the operation.

To accomplish successfully the budding of cacao in bamboo pots is, in the present state of knowledge of this subject, somewhat difficult. Much remains to be learned about this matter by further observation and experiment. It is hoped that the initial work carried out will lead to definite experiments being conducted on a considerable scale and under suitable conditions which will result in this work being carried out ultimately with the same ease and certainty that attends the budding of citrus stocks.

For success, good health and good growing condition of the stock is essential in order that the bark will lift readily from the stem. To obtain these conditions is somewhat difficult in places in which the bamboo joint is used for growing young plants. Though the bamboo joint is largely used in nursery work in the tropics, its small area results in restricting the roots, causing a pot bound condition, which arrests the growth of the plants. Possibly a system of first potting the seedlings stocks in small bamboos and afterwards transferring them to the largest size obtainable would be helpful in maintaining a vigorous growing condition; or the more general employment of baskets or clay pots when the latter are available at a cheap rate, would probably give the desired result

Experiments are also required to test the effect of growing stocks in beds without any restriction of the root area as in pots. If budding on stocks grown under these conditions proved easy, it remains to be seen whether the plants when strong could be successfully lifted for sale direct to planters, or for transfer to pots or baskets for sale.

Again the adoption of a method of keeping the stocks at the time of budding in frames, the pots being plunged in material with a temperature several degrees above the normal, might be tried with a view to forcing an active condition of sap. Also the action of certain manures in creating a good growing condition preparatory to budding might be experimented with.

Experiments are needed in regard to buds. Should these be taken from a branch which is resting or from one which is making a flush of growth? Should they be taken from well ripened wood or from the newer growth? The Dominica experiments tend to show that well ripened buds from a resting branch give the best results.

Much investigation is necessary into the various methods of budding, in the preparation of stocks and in care of plants after successful budding: also in regard to the best season of the year to carry on the work.

So many are the points which require elucidation that it has led to a suggestion being made to employ an expert propagator for the sole purpose of thoroughly investigating these matters in order to indicate clearly the best lines to follow in the work of propagating cacao asexually.

The choice of stock for grafting upon, despite various experiments, remains as limited as before, and is practically confined to the Calabacillo, the hardiest variety of *Theobrama Cacao*. It was suggested that perhaps some other species of Theobroma might prove suitable for the work, but up to the present efforts to graft the commercial cacaos upon stocks of *T. bicolor* and *T. angustifolia* have failed. Nevertheless efforts should be continued to collect and bring together the known species of Theobroma in order to follow this line of experimentation.

As is well known, the leading varieties of *Theobroma Cacao* are known respectively as Criollo, Forastero and Calabacillo. The first named is a delicate kind which yields high grade produce. It needs the best conditions for successful cultivation. The Forastero variety is a good all-round type, fairly hardy, a good yielder of medium grade cacao, and largely cultivated throughout the West Indies. The Calabacillo is the hardiest and yields a low grade produce. Between the main varieties there are many sub-varieties, the result, it is supposed, of natural crossing in plantations.

At present the best stock obtainable is the Calabacillo. Though a hardier stock is still desirable there is no doubt that areas of selected cacao growing upon Calabacillo stocks would represent an enormous advance from a cultural point of view over the mixture of seedlings on their own roots such as are grown to-day in the West Indies.

Owing to the crossing of varieties it is somewhat difficult to find the pure strain of Calabacillo cacao. Should grafting be taken up this matter of obtaining a large and reliable supply of a hardy stock will require very careful thought and experiment.

In looking for scions for propagation at present it is only possible to obtain them from those trees which the grower has had under observation for years, and which have given uniformly good results either in yield combined with good general health, or in the production of high grade seeds. Should the use of asexually propagated plants increase rapidly, it may be expected that the hybridist will undertake the crossing of good forms with a view to the production of the best varieties which, after being proved in the field, will be propagated on a large scale for sale to cultivators. In other words, it may be expected that the growing of cacao in the future will proceed along the lines found so successful in the development of orchard cultivation in temperate climates.

The art of budding and grafting, soundly applied, must lead to improvement, because such procedure naturally results in the rejection of inferior kinds. Every variety asexually propagated, whether for its fruit or for its flower, is worth the effort on account of the possession of some quality specially desired. Apart from such advantges as early fruiting, even quality of produce within given areas, higher returns per acre, and ability to resist disease better, it may be laid down as a principle that propagation by these means leads to the cultivation of selected varieties and consequently results in the elimination of unsuitable seedling types.

The experiments conducted in grafting and budding cacao have led to many discussions and expressions of opinion both verbal and written. One of the earliest and widely expressed objections advanced against the application of these methods was that the continued asexual propagation would tend to reduce the size and numbers of the seed until nothing but empty shells or pods would result. Enquiry showed that that those responsible for the above statement were under the impression that the seedless variety of orange, now so largely grown, was the result of the act of budding repeated over a long period. When the history of the Washington Navel orange was stated, and it was made clear that the seedless orange would have been lost to cultivators but for propagation by budding, by which method it has been fixed and perpetuated, no further criticism was attempted on these lines.

There appears to be no sound basis for assuming that budding or grafting when applied to cacao would result in decreasing the size or number of the seeds. Certain kinds of nuts which have been propagated by these means over long periods have shown no decrease in size or bearing powers nor is such result anticipated.

Fears have also been expressed that asexual propagation of cacao would lead to one type of cacao being cultivated over large areas, which variety might be liable to total destruction by some specific disease sweeping through the plantations. It is not anticipated that the application of budding or grafting would bring about the extended propagation of a single variety to the exclusion of others, but rather the reverse. In the case of apples, pears and other fruits, which have been propagated asexually for centuries, there is no case of a single type predominating. Further, it is highly improbable that a single variety of cacao could be found which would prove pre-eminent in useful qualities and also suitable for cultivation under the varying climatic conditions of cacao-growing areas throughout the Tropics. What is found in practice is that certain varieties prove to be suitable to the conditions of soil and climate of certain districts within which limited area they may be the leading kinds cultivated.

In support of this statement, orange cultivation may be instanced. The variety most favoured and grown during recent years is the well known Washington Navel. Its cultivation on an extensive scale in several countries has led to no cultural disaster, neither has the preference accorded to it prevented many other varieties from being grown, the fruits of which have been found to be suited to the markets and desirable on account of some special quality; nor has it prevented experiments being continued by experts in hybridizing with a view of raising new and improved varieties of oranges, which in due course are propagated by budding for sale to cultivators.

The view has been advanced that for the present it would be better to depend on seedlings and to endeavour to obtain hardy and prolific types by rigid seed selection, to be followed by removal of inferior plants from the field as soon as their nature was shown. There is no doubt that the first named suggestion has been in the past and is still being practised by careful planters, but the second one does not appear sound or practicable. The cultivator's argument against such a course would be to the effect that it is a better cultural and paying proposition to have an equally grown field with a proportion of inferior bearing trees rather than make the cultivation unequal when at the age of eight or ten years by removing even a small percentage of inferior seedling trees. Again the supplies recommended being seedlings, the results, owing to variation, might again be unequal, thus necessitating, after another period of time, further efforts in removals and replanting.

Contrast the above recommendations with the use of grafted trees. In this case the variety and its class of produce is known beforehand; there need be no removal of trees after years of growth, no loss of time, no vacant places in the cultivation with the attendant drawbacks of letting in the sunlight and wind at a time when the land should be covered by the trees.

The question has also been asked if in the breeding of new types of cacao for the purpose of being fixed and propagated by grafting, whether high quality of produce, productivity, or power to resist disease should be aimed at. If grafting is taken up by planters, these matters would adjust themselves. In Dominica where a high grade of cacao cannot be produced on a considerable scale, it may be expected that attempts would be made to find and cultivate hardy and prolific varieties while in countries which possess a soil and climate highly favourable, one would expect to find under cultivation the very best grades of cacao. At present it is not to be expected that the qualities of hardiness, productivity, and high grade of produce will be found combined in any single variety.

With regard to plantations on which the available areas are already fully planted, advice has been tendered by some that grafted cacao need not be considered in filling vacancies caused by deaths due to disease, etc., it being recommended to continue the use of seedling kinds.

When vacancies occur in closely planted areas it is often better not to attempt to fill the spaces but rather to leave them to be covered in by the adjoining trees which benefit by the additional room. Where there is sufficient space for a plant to thrive, it is surely better to place out a known variety than to leave matters largely to chance by planting seedlings.

A point on which information is needed in this connexion is the percentage of losses of trees on established plantations over a period of years. No such information appears to be obtainable, or indeed to have been recorded. On the best lands and in favoured situations there may be but little loss over long periods, but taking average conditions there is no doubt that plantations after a certain age, owing to deaths from disease and other causes, are being renewed at a more rapid rate than is generally supposed. The average profitable lifetime of the cacao tree does not appear to be known, but probably it does not exceed a period of from thirty to thirty-five years.

Consequently it would appear desirable in filling vacancies amongst established cultivation to use grafted plants. By careful selection varieties can be obtained which will give a return above the average yield of seedlings. Therefore the cumulative effect would be in the direction of increasing the yield per acre, an end desired by all planters.

It is only by planting tried varieties, and by a skilful system of manuring, soil management and sanitation that the highest possible returns per acre will be attained and maintained.

If the output of cacao in the West Indies is to be maintained as at present, a certain amount of new planting must be done each year in order to balance the deterioration which is going on amongst old cultivations. If the industry is to continue to expand, considerable additions to the planted area will have to be made annually. In opening new fields, efforts should be made to plant a proportion with selected grafted varieties in order that observant practical planters can compare the results with seedling cacao growing under similar conditions and under the same management. It is not to be expected that large areas will be planted with grafted trees immediately. The adoption of new methods in planting practice can only be gradual.

To accomplish successfully the initial stages, considerable effort, additional expense and greater care will be required than in the employment of seedlings. There is no reason to doubt that such efforts would be as certainly repaid as in the case of orange and other fruit industries in which budded or grafted plants are wholly employed.

Work Connected with Insect and Fungus Pests and their Control.

During the year further efforts were made to investigate a certain pest which had been known to do considerable damage in orange orchards for some considerable time. The Assistant Curator visited the infested district and was successful in obtaining specimens of attacked oranges. Later the Entomologist of the Imperial Department of Agriculture, H. A. Ballou, M.Sc., visited Dominica and made a careful investigation into the whole position. An article based on his report appeared in the *Agricultural News*, Vol. XII, No. 302. and is of such importance that it is reproduced here :—

A Pest of Oranges.

'The occurrence of a pest causing injury to oranges in Dominica has recently been reported.

HISTORICAL.

'This pest was first reported to this Department towards the end of 1907 when a few injured oranges were submitted for examination.

Note.—The output might be increased by the immediate adoption and application of a sound system of manuring on the many unmanured cacao estates in the West Indies. Such combined and immediate action is unlikely.

'In 1908, a further bad attack was experienced, and an investigation of the conditions was made by the Acting Curator, who submitted a preliminary report on the habits of the insect and the nature of the injury. That officer also recommended certain remedial measures which were tried.

'The Entomologist of this Department recommended an additional measure, viz., spraying with arsenate of lead, which was tried in 1909 with such satisfactory results that the pest was reported to be completely under control, and this satisfactory state of affairs was again reported in the following season (1910).

'Since that time no record of the insect has been received at the Office of the Imperial Department until October of the present year.

THE INSECT.

'The insect concerned in this attack is a small moth apparently of the family Tortricidae, but only a few specimens of the adult have yet been secured and its identity has not been established.

'It would appear to be related to the codling moth (*Carpocapsa pomonella*), and to the Natal codling moth (*Enarmonia batrachopa*), both of which are Tortricids which injure fruits in a manner similar to that of the orange pest in Dominica.

HABITS OF THE INSECT.

'From the reports of the agricultural officers in Dominica (the Acting Curator in 1908 and the Assistant Curator in 1913), it would appear that the attack begins in May or June, the eggs being laid on the surface of the fruit, and the larva (a small caterpillar) penetrating through the rind into the interior of the orange. During August, the larval stage is completed and the full-grown caterpillar leaves the fruit (which by this time has fallen to the ground) and enters the pupal stage amongst the leaves on the ground. About two weeks later the moths emerge. What becomes of the insect during the period from about September or October to the following May or June is not known.

INJURY TO THE FRUIT.

'The insect injures the fruit by penetrating the skin and living and feeding in the pulp of the orange. Often the characteristic puncture of the skin is seen, when on cutting open the fruit, no injury to the interior is found. It is likely that in such cases, the attack was begun on a very young fruit, in which the growth was so rapid as to prevent the development of the caterpillar.

'In other instances, the larva successfully penetrates to the pulp where it feeds and completes its development, causing a portion of the pulp to become a discoloured, rotten mass. Even when no further injury is caused than the puncture of the skin, the fruit is rendered unsaleable, on account of the discoloration at the point of attack and the malformation which often results.

REMEDY.

'Several remedial measures have been tried, the most successful of which appears to be arsenate of lead applied as a spray early in the season, in order that the newly hatched caterpillars may be poisoned as they attempt to eat their way through the orange skin.

CAUTION.

'Growers of oranges who may observe appearances leading them to suspect the presence of this pest on their fruit should inform the local agricultural officers, forwarding specimens and asking for advice as to the treatment to be adopted.'

A New Fungus on Lime Leaves.

In September 1912, a few lime leaves were sent in by a planter on the Windward coast which were attacked by scale insects in conjunction with which there appeared black bodies apparently fungoid in origin. It was at first thought that this fungoid growth lived parasitically on the scales but examination of further

material did not bear out this view, the black bodies being found scattered indiscriminately on the upper side of the leaves. They were not found on the under side nor on twigs.

The former Mycologist of the Department (F. W. South, Esq.) forwarded the material to Kew Gardens for its identification. The authorities there seemed at first in some doubt as to whether the bodies were of fungoid origin. Further material was requested and sent and the star-shaped dark bodies have now been finally determined as belonging to the genus Atichia. There are certain well defined differences between this species and the closely related species *Atchia Millardetii* from Java, and the Kew authorities have named this new species from Dominica *Atichia dominicana.**

It is now practically proved that this fungus does not live parasitically on scale insects, and the question now requiring elucidation is how it obtains its food. The fact that the lime trees having these bodies on their leaves were all growing under the shade of Castilloa rubber trees is suggestive.

Progress in the Chief Industries.

LIME INDUSTRY.

General Conditions.

It is satisfactory to be in a position to record another advance in the output of the staple industry of Dominica. Calculated in number of barrels the crop for 1913 amounted to 391,207 barrels of fruit, an increase of 21,207 over the crop of 1912.

The lime crop for the past five years calculated in barrels of fruit is recorded below :—

1909	...	..	284,000 barrels.
1910	...	...	369,000 „
1911	...	...	355,000 „
1912	...	...	370,000 ..
1913	...	...	391,000 ..

The flour barrel which is generally used for measuring limes varies slightly in size but the average capacity may be placed at 4·55 cubic feet. When filled to the top with limes the weight of the contents is approximately 160 lb. Calculated on this basis the weight of the crop gathered during 1913 was 31,000 metric tons.

The weather conditions were favourable and the rainfall again below the average. Unlike most countries, Dominica, owing to its high mountains and large area of forest, suffers from an excess of rain. Consequently a decrease in the annual precipitation is generally regarded as beneficial to the planting industries.

Scale insects on the whole appear to have been kept under control by the beneficial action of fungus parasites. Dominica is highly favoured in this respect, the climatic conditions being such as to maintain in full vigour and activity the several species of fungus which are known to prey upon scale insects. Still it should be borne in mind that this favourable combination is the result of a delicate adjustment of conditions, any displacement of which might tend to make lime cultivation in Dominica both difficult and expensive. Many planters will remember the after-effects of the heavy falls of volcanic ash in the island during the eruption of Mont Pelée in Martinique in 1902. The dust appeared to affect adversely the insect and fungus parasites of scale insects. The latter, unchecked, overran lime plantations. For two years their attacks inflicted great loss upon planters. In time conditions again became normal, and there has been no general outbreak since.

* See *Kew Bulletin* No. 2, 1914, pp. 54-63.

Market rates for concentrated lime juice and citrate of lime maintained a high level throughout the year. Never; since the industry assumed importance, has there been such a favourable year for lime growers.

The satisfactory returns per acre have led to the more general application of manures to lime fields. It is hoped that these efforts will continue, and that in a short time all growers will recognize that each tree must receive an application of suitable manure yearly if good crops are to be obtained and maintained.

The steady demand for lime seedlings continues, it being estimated that 300 acres are planted each year. This having gone on over a considerable period, there is annually a fairly large addition to the area of bearing cultivation.

Raw Lime Juice.

There was a considerable falling off in the export of this product which was largely due to a decreased demand in Canada. The exports of lime juice during the past four years are as follows:—

1910	...	...	203,792 gallons.
1911	...	...	311,377 „
1912	...	...	508,766 „
1913	...	..	336,728 „

During the year the Secretary of the Canadian and West Indian League drew attention to a report issued by the Chief Government Analyst, Ottawa, dealing with the adulteration of lime juice in Canada.

The report states that 'Out of thirty samples analysed, only five fully met the requirements of the standard set by law. Although several others approximate more or less closely to it, the report shews that no less than fifteen were adulterated according to the Act, while quite 30 per cent., as the Government Analyst points out, bore unmistakable evidence of having been reduced by the addition of water.

'The standard fixed by the Government for lime juice is that it shall contain at least 10 per cent. of solids and 7 per cent. of citric acid. Of the fifteen samples declared as adulterated, the report shows that ten contained less than 6 per cent. of citric acid, while three contained as little as 4·55, 3·78, and 3·50 per cent., or little more than one-half of the legal proportion. In the quantity of solids, of the same fifteen samples analysed, no less than eleven contained less than 7 per cent. while one of these had only 5·1 of solids, and one actually had only 3·6 or about one-third of the proportion prescribed by law. One of the samples, which on analysis was proved to contain only 3·50 of citric acid, showed unmistakable signs of dye having been added to give the article sold the colour of lime juice.

'In justice to the British West Indies, it may well be added that whatever adulteration occurs, does not take place there, but in the countries where the article is prepared.'

In this connexion it may be stated that old established British firms in the lime juice trade consider it of the highest importance to take every possible precaution to secure a high grade juice for use as a beverage. Such firms, in the interest of their business, find it necessary to possess their own lime estates in the West Indies in order that the fruits and the juice may be dealt with and shipped under expert management. Great care is taken that only sound ripe fruit is passed through the mill, all unsound limes being carefully excluded. The fruit is washed before crushing. The mills are fitted with three granite rollers, the first two of which lightly crush the fruit. This strong pure juice is used for making beverages, the second juice being converted into citrate of lime. After milling, the first juice must be stored in clean sound casks for shipment. All the appliances used, including the mill, must be kept in a clean condition.

Carefully prepared first juice can reach the manufacturers in Britain and Canada with very little loss of acid, and without the addition of preservatives, to which latter course there are many objections.

If a sound business in lime juice is to built up by Canadian firms it will be necessary for them to make arrangements to obtain supplies in the West Indies, which have been prepared under the best conditions. Several firms already do this, but evidently others (probably new to the business) have failed to do so. This may be largely due to inexperience in purchasing and handling lime juice. A strong pure juice will cost more, but in the end will prove satisfactory to both suppliers and manufacturers.

The keeping qualities of raw lime juice have recently been the subject of investigation by the Assistant Curator (see *Agricultural News*, Vol. XI, page 180).

In this case strong, medium and weak juices were stored for twelve weeks in open casks. The loss of acid at the end of six and twelve weeks is given below :—

	Six weeks, loss of acid.	Twelve weeks, loss of acid.
Strong juice	1·7 per cent.	12·4 per cent.
Medium „	3·6 „	18·9 „
Press „	70·0 „	93·0 „

The above rate of loss is minimized in the case of raw juice for export which is kept no longer than is necessary before being placed in closed casks for shipment. But the point to be remembered is that under equal conditions the weaker juice will deteriorate at a more rapid rate than the strong juice.

The above investigation shows how very necessary it is for makers of beverages to purchase high grade, carefully prepared lime juice. It is difficult to see how medium juice can meet the requirements of the Government standard in Canada for the pure article if the time required to place it upon the market is taken into consideration.

Citrate of Lime.

Compared with the year 1912, there was a considerable increase in the output of this product, but the production is still below that of the years 1910 and 1911. The shipments for the past five years are as follows :—

Year.	Quantity, cwt.	Value, £
1909	3,447	11,203
1910	5,194	16,880
1911	5,926	19,259
1912	3,910	11,991
1913	4,753	17,026

Fresh Limes.

The trade in fresh limes continues to expand. The number of barrels of fruit shipped was 43,832, an increase on the shipments during 1912 of 6,794. The year is remarkable on account of the high prices paid for fresh limes, prices which reached a level never expected even by those planters with unbounded confidence in this section of the lime industry.

Of the limes exported, the New York market took 43,026 barrels, and Canada, by direct shipment, 265 barrels. It is well understood that the latter market is supplied mainly by way of New York. The exports to the United Kingdom totalled 367 barrels, a decrease of 956 when compared with the shipments during 1912. Other small markets are Bermuda and Barbados which took 103 and 71 barrels respectively.

In the last progress report, reference was made to the action taken by a business house in New York, which handles the bulk of the fresh limes exported from Dominica, in appointing their own agent in Roseau to look after their local interests. The step taken has worked well and has resulted in improvements in packing, and in raising the standard of the fruit shipped.

The market for fresh limes is very active during March, April and May of each year,—months during which the production fails to meet the demand. Owing to the high prices prevailing at this period, the question arises whether it is not possible by cultural methods to increase the production during the months named. There is certainly need for experiments in this direction and it is hoped these will be undertaken by planters interested in this trade.

Lime Oils.

Prices for otto of limes, which is obtained by hand process, continued at a high level. Much ingenuity has been shown during recent years in attempts to devise and place upon the market a machine capable of extracting the oil from the fruits more speedily and at a cheaper rate than is possible by the old fashioned system of écuelling. In the progress report for 1912-13 reference was made to a machine invented for this purpose by two local planters. Information has recently come to hand to the effect that the cream separator is suitable for the purpose of separating the oil from lime juice, or in practice on estates, from the skimmings of the juice after sufficient dilution. Trials will shortly be made to test this statement.

The market rates for essential oil of limes, which is obtained by process of distillation, again ruled low.

The total values of lime oils shipped during 1913 were returned at £9,833.

The exports of lime products during 1913 were as follows :—

Product.	Quantity.	Value.
Concentrated lime juice	158,974 gallons	£ 60,842
Raw lime juice	336,728 „	15,083
Raw juice cordial	4,654 „	349
Green limes	43,832 barrels	39,298
Pickled limes	616 „	231
Citrate of limes	4,753 cwt.	17,026
Essential oil of limes	5,370 gallons	3,625
Otto of limes	1,505 „	6,208
	Total	£142,662

The increase in values over the crop of 1912 amounted to £45,989.

CACAO.

The export of cacao during 1913 was 9,560 cwt. valued at £24,759. This is 2,317 cwt., below the amount exported during 1912. Under existing conditions there appears to be no hope of the further development of this industry. Only the hardiest varieties can be successfully grown in the island, and then only if cultivated in sheltered areas near to the coast where the rainfall is low and there is ample protection from the wind.

Except in one or two instances there has been no development of this cultivation on estates for a number of years, the capital and energies of planters being almost exclusively devoted to furthering the interests of the lime industry.

For a long period, cacao remained the favourite industry of small growers. During recent years the peasants have followed the example set by estates and now devoted their attention to the cultivation of the hardy and profitable lime.

The exports of cacao during the past five years are recorded below :—

Year.	Quantity, cwt.
1909	10,844
1910	11,272
1911	10,055
1912	11,877
1913	9,560

COCO-NUTS.

In the progress report for 1912-13 it was mentioned that though the export of coco-nuts was growing but little attention has been given during recent years to the planting of new areas although local climatic conditions were highly satisfactory for this cultivation.

Since that time a considerable change has taken place. Under the direction of a syndicate, a very large area in the La Soye District is now being planted in coco-nuts, and similar efforts, though on a smaller scale, are going on in other parts of the island. Should the areas now being planted be successfully brought to the fruiting stage, coco-nut cultivation will, by that time, have become an important local industry.

The export of coco-nuts during the past five years is given below :—

Year.	Number.
1909	321,145
1910	331,044
1911	402,622
1912	539,791
1913	448,747

Although the export of coco-nuts was lower than during 1912, it is clear that there has been no falling off in production. The difference in number exported is explained by the fact that very large quantities of selected nuts have been laid down in nurseries for the purpose of supplying the considerable local demand which has arisen for plants.

MINOR PRODUCTS.

The quantities and values of the minor products exported during 1913 are given below :—

Produce.	Quantity.	Value.
Oranges	1,425 barrels	£1,119
Orange-oil ...	165 gallons	582
Bay leaves ...	443 cwt.	371
Pay oil	116 gallons	333
Starches	404 cwt.	377
Coffee	25 cwt.	70
Hardwood ...	77,903 feet	811

Efforts in Connexion with General Agricultural Progress.

THE PREPARATION OF LIME JUICE PRODUCTS.

Testing of Lime Juice.

As in previous years the facilities offered to planters of having their juice tested at a nominal fee was continued during the year. Twenty-six samples were examined viz., thirteen concentrated and thirteen raw juice samples. This shows a considerable advance over the number analysed in previous years.

Concentrated juices are often sent in to control the reading of the citrometer which is used in boiling. The raw juice samples are usually sent in to check the tests which are made by parties who purchase raw juice locally. In one instance a planter visited to ascertain whether his juice came up to the standard required by a Canadian firm viz. 7·5 per cent. citric acid.

It is clear from the above that as the fact becomes better known that the Department is in a position to have these samples tested, greater use will be made of the facilities offered.

Examination of Lime Oils for Adulterants.

A case of the suspected adulteration of a sample of lime oil with kerosene oil was referred to the Government Chemist, Antigua, there having been one or two cases of a similar nature reported to the Department on previous occasions. A request was also made for a simple method of determining the presence or absence of mineral oil adulteration.

Mr. Tempany reported that he was of opinion that the sample sent was genuine lime oil, and at the same time gave an account of a method which had been devised in the laboratory for testing the presence of kerosene in lime oil.

It consists of the addition of about twice the volume of 93 per cent. alcohol to the suspected sample. When large quantities of the adulterant are present, the fact is at once revealed, upon the addition of alcohol, by a separation of the oil into two liquids, the alcohol being miscible with lime oil, but not with kerosene. Upon standing for a short time the liquids will have settled into two layers, the one above being colourless—kerosene—the one below being a mixture of lime oil and alcohol. Smaller quantities of kerosene can be recognized by this test, but it is necessary to allow the mixture to stand for a longer period of time in order that the kerosene may separate out on the top of the liquid; it is not clear what is the limit of adulteration detectable in this way; separation will usually have been completed after a lapse of twenty-four hours.

The addition of alcohol to a lime oil which has been heavily adulterated with kerosene oil, produces a turbid appearance in the liquor. Some genuine samples of lime oil, however, become turbid in the presence of alcohol, so that the production of a turbidity upon the addition of alcohol cannot be regarded as a positive proof to the presence of kerosene: it is necessary to allow the mixture to stand and separate out before a definite opinion can be pronounced.

A further indication of the presence of kerosene oil in a sample of lime oil is afforded by the specific gravity. The specific gravity of a genuine sample of lime oil varies between 0·876, to 0·886, whilst that of kerosene is about 0·810. A sample of lime oil possessing a specific gravity very much below 0·871 may therefore be suspected as having been tampered with.

This information is likely to prove of considerable value in cases where adulteration is suspected.

Extension of Interest in Agricultural Matters.

PERMANENT EXHIBITION COMMITTEE.

There were several meetings of the Permanent Exhibition Committee during the year, the Curator of the Botanic Gardens as Honorary Secretary being present. During the absence of the Chairman of the Committee for the last two months of the year, the Curator acted as Chairman and the Assistant Curator as Secretary.

As on previous occasions the staff of the Botanical Department were responsible for the preparation, packing and shipping of the various exhibits to the Exhibitions.

During the year Dominica was represented at one exhibition only, viz., The Royal Agricultural Show (Overseas Section) at Bristol, in June. In addition to this, a considerable amount of the time of the officers of the Department has been occupied in preparing samples of rubber for the exhibition to be held in July 1914. Also fortnightly shipments of a crate of limes have been forwarded to England for free distribution. Mr. A. E. Aspinall, Secretary of the West India Committee, having kindly undertaken to make them up into small parcels for distribution amongst people of influence in the United Kingdom.

The efforts of the Committee in connexion with the Royal Agricultural Show at Bristol seem to have been entirely successful. This is due to a large extent to the interest which Mr. Aspinall takes in displaying the exhibits to the best advantage. The Permanent Exhibition Committee is very fortunate in having the co-operation of the West India Committee who take charge of the exhibits on arrival in England and carry out all the arrangements in connexion with the exhibitions.

Extracts of Mr. Aspinall's report to the Committee are given below :—

'Your Permanent Exhibition Committee wisely specialized with limes at this exhibition, and the result was a very fine display of that fruit, which attracted an immense amount of interest and attention. In spite of the historic associations between Bristol and the West Indies, few Bristolians appeared to be acquainted with the many advantages of limes over lemons, and this applies also to the numerous visitors from all over the country. A notable exception was His Majesty the King, who, as you will have noted, honoured the West Indian Stand with a visit, and said as he passed along the exhibits, "I want to see the Dominica limes." His Majesty made several inquiries regarding the fruit, and asked whether they had to be in cold storage or carried in the ordinary way. His Majesty expressed himself as being greatly interested, and said that he hoped the West Indies would continue to prosper.

'The fruit, without exception, arrived in excellent condition, and the various bottled specimens of concentrated lime juice, otto of limes, essential oil of limes and citrate of lime, were all in good order. It astonished visitors to learn to how many different uses limes could be put.

'A great feature of the stand was the loyal inscription "God Save The King" in Dominica limes, and the distribution of free samples, which were greatly appreciated.

'Following our former practice, we distributed the samples in bags marked "Dominica Limes," and gave with each one leaflets "Lancet on Limes" and "About Dominica Limes," specimens of which I send herewith. I also send you copies of the pamphlet "Notes on Dominica," which we had prepared the cost being defrayed by the advertisements, which we secured.

'I append hereto a list of names of visitors to the exhibition who appeared to be specially interested, and would suggest that it would be desirable to send them a letter from the colony, thanking them for the interest which they showed, and requesting them to ask their grocer or fruiterer for Dominica limes, pointing out that this fruit can now be obtained through the usual trade channels.

'In accordance with the request contained in your letter of June 7, the lime products in bottles were delivered to the Royal Botanic Gardens, Kew, after the exhibition, and I enclose a letter of acknowledgment received from the Lieut.-Colonel Sir David Prain, C.M.G., Director.'

Mr. Aspinall's suggestion of forwarding a circular letter to the people who showed particular interest in the Dominica Exhibit was carried out, and close on 400 copies of the following letter were posted to persons residing in Great Britain :—

'Dear ,

My Committee has been informed through its London representative (Mr Algernon E. Aspinall, The Secretary of the West India Committee, 15, Seething Lane, London, E. C.) of the interest you took in the Dominica Limes shown at the recent Show of the Royal Agricultural Society at Bristol.

'The planters of Dominica are endeavouring to popularize the fruit in the United Kingdom, and they hope to receive your assistance and support. Limes grown in this British Colony are greatly preferred by most people to foreign lemons, and I trust that you will insist on getting Dominica limes from your fruiterers and grocers who now know where they can obtain them. I hope also that you will recommend the fruit to your friends.'

The Victoria Museum.

The Curator has been one of the Directors of the Museum since its inception in 1911. The staff of the Department has been made responsible for the economic section. During the year numerous additions were made to this section. A col-

lection of Dominica fruits preserved in formalin and placed in large glass jars is very attractive and commands considerable attention. A collection of some of the more common of the Dominica grasses was prepared, mounted and named.

Most of the bottles were relabelled and, when necessary, cleaned and refilled. The tubes displaying the physical composition of the samples of Dominica soils referred to in the report on the 'Soils of Dominica' were remounted on one large board and hung up in a conspicuous position in the museum.

Messrs. Rowntree of York presented the museum with a collection of the various products manufactured from cacao beans grown in Dominica.

Details of Administration.

EXPENDITURE, RECEIPTS, SALE OF PLANTS, ETC.

The votes for the Agricultural Department for the year from local funds were as follows :—

	£	s.	d.
Salaries : Curator, Assistant Curator, and Foreman	511	0	0
Travelling expenses	50	0	0
Maintenance, Botanic Gardens	280	0	0
Cultivation of saleable products	220	0	0
Fumigation of imported plants	5	0	0
Testing of lime juice	5	0	0
Maintenance, Public Gardens	15	0	0
Telephone rental	8	0	0
Purchase of special manures	10	0	0
Printing Reports, etc.	20	0	0
Prize Holdings Competition	25	0	0
Lime cultivation experiments	50	0	0
„ „ „ (Special)	62	0	0
Permanent Exhibition Committee	75	0	0
Total	£1,336	0	0

The actual expenditure for the year was £1,255 3*s.* 5*d.* The receipts from sales of plants and cacao, fruits and seeds amounted to £433 7*s.* 9*d.*

The grant to meet the cost of training agricultural pupils was as follows :—

	£	s.	d.
Overseer	30	0	0
Allowances to pupils	110	0	0
Tools, Implements, etc., ...	20	0	0
Labour	15	0	0
Contingencies	10	0	0
Total	£185	0	0

The expenditure under this head was £184 17*s.* 1*d.*

The amount available for 'Special Services' on April 1, 1913, stood at £238 0*s.* 10*d.* This sum was formed of lapsed balances on the Imperial Grant for the Agricultural Department in former years. It is controlled by the Imperial

Commissioner of Agriculture, who may, from time to time, recommend for the approval of the Secretary of State expenditure from this source for the purpose of adding to the equipment of the Agricultural Department, and in special work in connexion with agricultural experiments. The following payments were authorized during 1912-13 :—

	£	s	d.
Assistant Curator: increment of salary	25	0	0
Overseer: increment of salary	6	0	0
Special experiments with limes	19	19	5
Apparatus, appliances, etc., ...	25	5	4
Purchase of books	8	5	6
Iron Labels for plants	4	9	4
Importation of exotic plants		15	9
Total	£89	15	4

STAFF CHANGES.

A. D. Thorpe, Assistant in office work, vacated his post in April. H. A. Frank, a former pupil of the Department, now fills this position.

The Curator was absent from the colony on vacation leave from July 20 to September 11. The Assistant Curator was appointed to act as Curator during his absence.

ADDITIONS AND REPAIRS TO BUILDINGS, NURSERIES, ETC.

A drinking fountain was imported and erected in the Gardens by the Public Works Department at a cost of £35.

CORRESPONDENCE AND DISTRIBUTION OF INFORMATION ON AGRICULTURAL MATTERS.

During the year 1,449 letters were despatched from the office, and 150 minute papers were dealt with. Sixty-five copies of the various issues of the *West Indian Bulletin* and 130 copies of the Annual Report on the Botanic Gardens and Experiment Stations for 1912-13 were distributed free of charge to leading officials, planters, and others in the island.

The Gardens being conveniently situated near Roseau are frequently visited by planters and others desiring information on agricultural matters.

The library attached to the Station continues to extend. Books to the value of £9 were purchased during 1913.

Works on the following subjects are available for reference within the office :—

Agriculture	49
Chemistry	20
Botany	41
Horticulture	11
Pathological	16
Miscellaneous	18
Total	155

In addition the publications of the various Tropical Departments of Agriculture are regularly received and bound together, and are also available for reference.

VISITS TO ESTATES.

The following estates were visited by officers of the Department during 1913-14 :—Felicité, Belvedere, Stows, Ridgefield, Grand Coulibri, Wall House, La Haut, Canefield, Corona, Sylvania, Lancashire, Middleham, Riversdale, Gleau Manioc, Stonehill, Jacko, Saltoun, Harris, Sherwood, Hillsborough, Picard, Moore Park, Blenheim and Hampstead.

In addition a large number of small holdings in the Grand Bay and La Plaine districts were visited.

OFFICIAL VISITS TO THE STATION.

VISITS BY OFFICIALS OF THE DEPARTMENT.

Hon. Dr. Francis Watts, C.M.G., Imperial Commissioner of Agriculture for the West Indies, arrived from a visit to the Northern Islands on December 15. He visited and inspected the Botanic Gardens and the Experiment Station ; also the lime experiment plots at Morne Bruce. Dr. Watts left for Barbados the same day.

H. A. Tempany, Esq., B.Sc., F.I.C., Government Chemist and Superintendent of Agriculture for the Leeward Islands, arrived in Dominica on August 17 and returned to Antigua on August 28. During his stay he spent several days in the Gardens investigating the condition of the various Cacao Experiments Plots. Accompanied by the Assistant Curator, he visited Wall House estate and witnessed the working of the Davenport & Allport Ecuelling machine. He also visited Canefield, Sylvania, Middleham, Stowe, La Haut and Picard estates. On August 23 Mr. Tempany attended and addressed a meeting of the Planters' Association.

H. A. Ballou, M. Sc., Entomologist to the Imperial Department of Agriculture, arrived in Dominica on November 9 and proceeded to the Imperial Road where he carried out certain investigations in connexion with the orange moth. Mr. Ballou left for Barbados on November 11.

Mr. Ballou also called at the Gardens on January 16 and February 11 on his way to and from the Northern Islands.

OTHER VISITS.

His Excellency the Governor and Commander-in-Chief of the Leeward Islands visited the Gardens on November 21.

P. H Lamb, Esq., Director of Agriculture, Northern Nigeria, paid a three days' visit to Dominica arriving on November 20.

R. Gill, Esq., of the Agricultural Department, Southern Nigeria ; and W. D. Scotland, Esq., of the Agricultural Department, Sierra Leone ; arrived in Dominica on November 22 on an official visit to study agricultural methods in the West Indies. They remained in Dominica fifteen days. During their visit they made close enquiries into the working of the Department and they were shown over several typical estates.

Dr. Sambon and Professor Jennings, members of a Scientific Commission, paid short visits to Dominica during the year, and were given every assistance possible to facilitate the object of their visits.

MISCELLANEOUS.

Experiments with Dynamite in Agriculture.

Interesting experiments with dynamite in connexion with soil improvement have recently been carried out on one of the Government lime cultivations. In the first place fifty-six holes were exploded amongst some old trees on poor soil in order to see what effect would ensue. An area has been left untreated in the same field as a control.

A second experiment had for its object an investigation of the value of dynamite for preparing holes for planting budded lime plants. Half the holes have been opened up with the explosive; the other half by means of an iron bar and spade, in the usual way. It is hoped to start another experiment of a similar kind with seedling limes.

It is believed that if the cost works out to be reasonable, explosives may be used with great advantage in preparing holes for limes and other citrus plants in Dominica. As regards the opening up of the subsoil on established lime plantations, great care will have to be exercised, since, should the experiments be followed by strong winds or heavy rains, the effect on the trees, owing to their having lost to some extent their hold on the soil, might be disastrous. Methods which have been found highly satisfactory with deciduous fruit trees in temperate climates may require considerable modification in the case of evergreen fruit trees grown in the Tropics.

From information lately received, it is certain that a considerable number of experiments with dynamite will be undertaken on lime estates in Dominica in the course of the next few months, and the results of these and the ones just described will be awaited during the next year or two with great interest.

PLANT AND SEED EXCHANGES, FOREIGN AND LOCAL.

Contributions of seeds and plants were received from the following: Imperial Commissioner of Agriculture; Royal Botanic Gardens, Kew; United States Department of Agriculture; The Technological Museum, Sydney; Botanical Departments of Jamaica and Trinidad; Botanic Gardens of Saharanpur, Mauritius, Grenada, St. Vincent, St. Lucia and Antigua; also from Eugene Andre, Esq., of Trinidad, and A. Archer, Esq., Antigua.

Seeds and plants were sent to: Royal Botanic Gardens, Kew; Jardin Colonial, Nogent-sur-Marne; Botanical Department, Trinidad; Departments of Agriculture Fiji, Bermuda, Barbados, Mauritius and St. Croix; Botanic Gardens of Bangalore, India; Darwin, Australia; St. Lucia, St. Vincent, Antigua, St. Kitts and Nevis, and also to His Lordship the Bishop of Roseau, Hon. J. C. Macintyre, Dr. Nicholls, C.M.G.; Dr. Brown, British Honduras; Eugene Andre, Esq., Trinidad; and to A. Archer, Esq., Antigua. Also seeds were forwarded to the following Government Schools for school garden purposes: Delices, Colihaut, Wesley, Roseau, Mahaut and Marigot.

METEOROLOGICAL RETURNS.

The rainfall at the Botanic Gardens for 1913 was 69·90 inches. This is 6·15 inches more than in the preceding year. The mean rainfall for twenty-one years is 77·5 inches. Reference to the diagram showing mean monthly rainfall for twenty-one years shows at a glance that the month of April is the driest and that July is the wettest.

Below will be found the table showing the monthly and yearly rainfall at the Botanic Station from 1892 to 1913—a period of twenty-one years. This is followed by a diagram illustrating the same data.

Following the above will be seen the table showing the monthly rainfall at the thirty-three recording stations for 1913.

From this table it will be observed that the mean rainfall for the thirty-three stations is 118·09 inches, an increase of nearly 20 inches over that for 1912. By taking the island in districts we obtain the following returns: the twelve Leeward coast stations registered, on an average, 75·49 inches; the three South-windward coast stations registered, 131·94 inches; the twelve Inland stations registered 161·63 inches, and the six La Soye coast stations registered an average of 110·47 inches.

JOSEPH JONES,

Curator.

RAINFALL AT THE BOTANIC STATION, DOMINICA, 1893-1913.

Month.	1893	1894	1895	1896	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	Mean monthly rainfall.
January	3·62	10·20	4·03	5·52	2·60	3·00	6·78	2·25	1·52	2·01	3·10	7·92	3·86	3·74	4·48	1·56	2·30	5·20	11·16	8·24	7·18	4·95
February	7·65	4·99	1·09	1·23	3·21	2·11	3·00	1·15	0·88	0·43	5·01	5·58	2·56	2·04	3·82	1·16	5·02	11·42	4·00	1·32	2·32	3·33
March	2·97	4·39	5·35	2·73	3·36	1·53	1·32	3·56	3·27	2·69	2·11	2·16	4·38	0·90	1·96	3·68	2·08	1·16	3·11	1·66	7·29	3·09
April	1·71	2·33	2·92	1·27	1·39	0·75	0·60	1·29	0·25	2·80	0·57	1·61	1·90	3·18	2·66	3·08	8·12	2·86	5·00	3·38	1·57	2·18
May	5·15	3·09	10·08	6·12	12·75	1·19	1·76	7·62	2·05	6·86	2·44	1·58	4·32	3·78	1·61	2·24	1·92	7·30	11·16	1·56	3·16	1·67
June	16·12	8·22	3·19	8·23	6·50	11·78	7·23	5·59	12·18	12·89	9·02	6·00	5·54	9·16	5·54	6·16	9·00	11·26	6·51	5·41	3·49	8·20
July	13·67	8·62	7·13	14·88	8·80	14·75	10·08	10·50	22·96	9·74	8·91	10·38	6·10	10·10	8·00	9·22	9·86	12·60	8·08	5·83	7·57	10·37
August	11·86	5·84	9·67	7·07	8·87	16·35	6·32	7·34	13·53	7·41	18·11	7·69	14·18	7·30	7·40	9·41	13·12	10·22	11·13	4·88	10·93	9·96
September	11·15	8·22	17·42	6·47	4·51	17·89	7·04	5·28	5·86	8·62	9·69	11·32	8·92	10·88	11·60	7·52	6·44	8·90	15·34	3·32	8·39	9·26
October	8·94	14·41	11·32	3·93	8·42	7·97	1·81	6·60	4·84	5·75	12·73	10·21	9·10	8·12	7·80	5·12	13·10	3·82	7·06	7·26	10·10	8·02
November	3·18	6·14	11·21	16·81	7·81	6·55	5·02	3·49	6·43	11·20	4·17	3·13	5·48	9·58	5·98	1·96	4·36	5·40	6·91	11·20	1·28	6·68
December	10·61	4·99	5·66	6·60	10·55	5·86	2·19	3·68	4·32	7·16	14·23	4·84	5·72	2·94	8·42	7·80	5·82	7·50	7·11	6·66	2·72	6·45
Total	98·93	81·44	89·07	80·86	78·77	89·73	53·15	57·75	81·09	77·46	90·72	72·45	72·06	72·02	69·30	59·91	81·14	90·64	97·26	63·75	69·90	...

RAINFALL RETURNS, DOMINICA, 1913.

Station.	January.	February.	March.	April.	May.	June.	July.	August.	Septr.	October.	November.	December.	TOTAL.
Antrim Valley ...	10·71	4·00	11·39	3 36	7·48	7·15	10·88	21·00	10·36	10·93	6·69	5.53	109 48
Batalie	2·74	1·49	3 00	1·70	0·56	2·89	2·50	16·31	3·65	4·19	3·15	1·90	44·08
Bellevue	19·24	5·31	14·74	8·36	14·71	10·74	13·32	24·85	15·89	20·81	15·77	9·63	173·37
Blenheim	11·49	2·69	6·94	8·06	9·49	8·63	6·83	19·96	14·98	12·01	18·67	6·02	125·77
Botanic Gardens ...	7·48	2·32	7·29	1·57	3·46	3·49	7·57	10 93	8·39	10·40	4·28	2·72	69·90
Canefield	5·68	1·90	5·74	1·54	3·12	3·75	6·68	14·90	8·16	9·37	4·06	2 66	67·56
Castleacre	10·95	3·33	11·74	3·47	6·58	7·72	10·53	24·04	12·88	15·47	6·00	4·53	117·24
Castle Bruce .	8 76	1·92	4·52	12·04	8·28	6·02	8·58	21·71	11·80	20·94	19·45	6·33	130 35
Concord	14·83	3·81	9·03	14·44	10 29	9·72	8·93	25 17	15 69	25·12	22·08	7·64	167·05
Corlet	23·05	4·92	16·39	10·52	11·48	12·78	15·12	29·27	19·54	28·22	21·19	10·66	203·14
Everton	11 01	1·97	9·44	2·14	7·13	6·39	11·10	19·58	21·95	14·52	8·52	5·71	119·46
Gleau Manioc .	27·51	6·79	26·14	18·95	22·74	13·74	23·12	39·70	21·28	26·57	33·91	11·36	271·81
Goodwill	7·16	2·62	7·12	1·58	3·00	3·28	6·68	9·80	7·58	11·29	4·64	2·89	67·94
Governor	11·96	3 99	8·70	14·18	9·61	10·77	8·41	22 76	15·70	17·38	21·54	7·57	152·60
Hampstead ...	9 28	2·59	6·00	7·73	6·13	6·13	5 63	15·83	12·95	10·04	15·23	3·38	100·92
Hatton Garden ...	8 91	2 01	3·98	12·29	8·99	6·69	5·13	21·05	10·65	18·47	15·57	4·70	118·44
Hillsborough ..	6·61	2·50	5·16	2·35	3 09	4·65	6·05	16·03	6·22	7·09	4·96	3·61	68·32
Kinellan	16·58	5·66	15·92	8·00	7·91	9·16	12·73	23·30	18·07	9·77	16·60	7·07	151·07
La Haut ...	9·26	2·70	8·43	3 64	6·98	5·58	9·45	14·19	10·37	13·24	7·34	4·17	95·35
Lisdara	20·02	4·78	18·11	10·81	14·11	10·11	12 02	19·94	12·00	24·67	19·24	5·06	170·90
Londonderry ...	6·29	1·86	3·42	11 75	5·26	5·47	5 29	17·88	10·82	11·75	14·48	4·84	99·11
Melville Hall ...	8·90	2·67	5·02	11·54	6·85	6·50	5·33	21·15	11·25	14·65	16·11	4·72	114·69
Moore Park ...	11·86	2·34	6·53	9·65	6·20	6·68	5·97	16·25	15·35	10·78	17·90	4·97	114·48
Morne Bruce ...	8·61	2·54	7·68	1·89	3·69	4·05	7·83	10·89	8·34	10·47	3·88	2·81	72·68
Picard	10·70	2·19	7·22	3·12	5·46	6·07	5·40	15·84	7·13	8·99	9·52	4·85	86·49
Pte. Mulatre ...	13·85	2·55	3·75	4·13	11·42	2·74	5·46	22·73	11·18	16·98	15·95	9·00	119·74
Rosalie	11·26	4·99	4·50	11·57	13·40	8 06	8·81	26·58	11·97	19·81	19·12	5·68	145·75
Shawford	14·76	3·06	19·78	8 19	10·92	12·29	14·59	27·80	16·20	13·69	13·38	3·83	158·49
Snug Corner ...	14·98	2·30	14·99	7·40	9·78	9·38	12·33	20·60	16·32	16·32	11·72	6·62	142·74
Soufrière	6·92	2·11	2·16	2·39	2·46	3·27	5·51	13·41	10·49	10·61	5 75	4·07	69·45
St. Aroment ..	10·01	1·78	11·16	2·57	4·67	5·13	8·29	15·35	10·16	8 71	4·79	2·61	85·23
Wall House ...	2·95	1·45	3·50	1·77	3·02	5·27	7·28	12·93	8·70	7 80	2·55	2·25	59·47
Woodford Hill ...	8·08	1·95	4·88	12·24	7·20	5·09	4·95	16·37	10·76	14·54	14·64	3·19	103·89

Mean Rainfall,	33 Stations ..	118·09 inches
,, ,,	12 Leeward Coast Stations	75·49 ,,
,, ,,	3 Windward ,, ,,	131·94 ,,
,, ,,	12 Inland Stations ,,	161·03 ,,
,, ,,	6 La Soye Coast Stations	110·47 ,,

Manurial Experiments in connection with Lime cultivation.

Reference to the progress report for 1912-13 will show that a series of manurial experiments with lime cultivation was laid out in the valley beyond Morne Bruce during that year.

The experiments may be divided into two series :—

SERIES 1—with old lime trees which existed on the plots when the experiment was laid out.

SERIES 2—with young lime trees only now being planted.

The condition of the limes in series 1 when the experiment was commenced in January 1913, may be gathered from the following description taken from last year's Annual Report and reproduced here for ease of reference :—

'The limes in question were planted during 1893 by the boys of the Reformatory School, a Government institution which existed at Morne Bruce from January 1893 to December 1895. To the end of the latter year the plants were cared for, but from that time to the present the land has remained in bush amongst which the limes have struggled to exist. On the bush being removed, the lime plants were found, as expected, to be poor in condition and attenuated in appearance. With attention, these poor limes should develop into healthy well-shaped trees in the course of time.

'It is to be expected, under the condition stated above, that the plots are not complete. Vacancies occur in each, which will be filled in as soon as possible.

'The land occupied by the plots is sloping in character, conditions typical of large areas of lime cultivation in the island.'

In twelve months these old trees have made quite satisfactory progress. They look green and healthy, being remarkably free from attacks of scale insects. It will, however, take some considerable time before they will present the appearance of well grown trees. The vacancies referred to above were all filled in in July last, and the young plants are making good growth.

The area of existing lime trees was sufficient to allow of eight plots of approximately ¼-acre to be started.

Each plot received its first annual quotum of manure in July and the limes from each plot have been collected and measured throughout the crop season.

The following table shows the manurial treatment that each plot has received and the number of standard barrels of 4½ cubic feet capacity which were picked from each plot and their equivalent per acre :—

Letters on Station plan.	Manurial treatment	Barrels per plot.	Barrels per acre.
A	Dried blood 4 cwt. per acre Basic slag 4 „ „ Sulphate of potash 1½ cwt. per acre	6	24
B	No manure	5¾	23
C	Mulched with grass and bush 5 tons per acre	3½	14
D	Dried blood 4 cwt. per acre	4¼	17
E	Sulphate of ammonia 2½ cwt. per acre ...	8	32
F	Sulphate of potash 1½ „ „ ...	1½	6
G	Basic slag 4 cwt. per acre	4	16
H	Dried blood 4 cwt. per acre Basic slag 4 „ „	7	28

The above figures of yields for the first year show at a glance the utter state of neglect of the trees when they were taken over especially when it is borne in mind that many well managed estates obtain a crop of 150 to 180 or more barrels per acre.

Again it should be pointed out that the variation in yield of the individual plots is due to the original unevenness of the plots rather than to the effects of any particular manurial treatment. It will be several years before reliable information on this latter point will be forthcoming, but the progress of the plots from year to year will be awaited with keen interest.

SERIES 2—with young limes.

This series consists of eight ¼-acre plots on fairly level land adjoining the older trees. They were planted in July 1913, and have made quite a fair start. It is the intention to duplicate with the young cultivation the experiments carried on with the older trees, thus confirming or otherwise the results obtained.

ADDITIONAL EXPERIMENTS WITH LIME CULTIVATION.

Towards the end of the year under review the remaining portion of the old limes existing near the lime experiment plots was fenced in. Most of this is unsuited for manurial experimental plots—being too steep. Two additional plots however have been formed of approximately ¼-acre each.

The soil of these two plots is in very poor heart, being very compact through want of cultivation and the trampling of cattle. Charges of dynamite were exploded in fifty-six holes amongst the trees in one-half of one of the plots, the remaining half being left untreated as a control.

The other plot is to be limed and mulched annually and the yields recorded.

Up to the time of writing the dynamited portion has not shown any apparent improvement as a result of the treatment. Further experiments with soil dynamiting are contemplated during the current year, a small vote having been approved by the Legislature for this purpose.

Within the enclosed area mentioned above there is sufficient unoccupied land to start six additional ¼-acre plots. This land has been cleared of bush, etc., and lined out into plots divided by drains. Three of these will be planted with ordinary limes as soon as possible and will be available for duplicating the lime-mulch plot and any others that may be subsequently laid out.

The remaining three will be planted with limes budded on sour orange stocks—two ¼-acre plots with the ordinary spiny budded limes and one ¼-acre with budded spineless limes.

Advantage has been taken while planting these additional plots of testing the efficiency of holes made by dynamiting as compared with the ordinary spade made holes. Every alternate row of holes in the budded lime plots was dynamited in December, and the remaining rows were soon after made with the spade.

This should demonstrate in a very marked way any advantage which one method may possess over the other.

It will be evident that this additional work in the newly established lime experiment plots has been a severe strain on the time and energy of the small staff of the Department during the year under review.

Agricultural Education in Dominica.

AGRICULTURAL INSTRUCTION AT THE BOTANIC AND EXPERIMENT STATION.

Training of Pupils.

There continues to be some doubt in the minds of several planters and others in Dominica as to the scope of the training which the pupils of the Department receive at the Botanic Gardens.

The following extracts taken from a memorandum printed and circulated widely in Dominica previous to the holding of the competitive examination for new pupils in July is reproduced here with the object of clearing any doubt existing :—

'The Agricultural Department is prepared to receive a limited number of pupils for practical training in agriculture.

'The course of training will extend over a period of two years, and pupils will be required to engage in the various branches of field and nursery work with a view to acquiring a sound knowledge of practical agriculture.

'Candidates must be at least sixteen years of age, healthy, and physically fit, and have shown aptitude for instruction in agriculture. They must have attained a standard of elementary education corresponding to the sixth standard of the Primary Schools, or sufficient to satisfy the Agricultural Superintendent that they are capable of taking full advantage of the course of training offered. They must be youths of good character and be recommended by a responsible person.

'Subject to good behaviour and satisfactory progress in their work, pupils will be granted an allowance beginning with 3/6 per week and advancing to 4/- per week in the second half-year, 4/6 in the third and 5/- in the fourth half-year of their training. Pupils whose conduct and progress are unsatisfactory will not be retained under instruction.

'Where the parents or guardians of any accepted pupil do not reside within the limits of Roseau, the propriety of the grant of a small additional allowance towards the expenses of the pupil's residence within easy access of the Botanic Station will be considered.

'The course of instruction will be directed towards the acquirement of a practical knowledge of the methods of plant propagation, nursery work, planting and care of staple crops such as limes, oranges, cacao, rubber, vanilla, fruits, and the commonly cultivated provision crops. The course will include instruction and practical work in the various forms of tillage, drainage, weeding, sowing, transplanting, use and application of manures and mulches ; the treatment of insect and fungoid pests, pruning, budding, grafting, packing, transporting and planting out young plants, picking, preparing, and packing crops for market, etc.

'In addition to the practical instruction and the carrying out of the above outlined work at the Botanic and Experiment Stations, the pupils will receive an appropriate amount of class instruction in the fundamental principles underlying the practical work. They will also be required to undertake a prescribed amount of home reading and study under the direction of the Agricultural Superintendent.'

Number of Pupils.

There were six pupils in training on April 1, two having entered in August 1911, and four in January 1912. Two boys completed their training in August: one (H. A. Frank) was appointed clerical assistant to the Department, and the

other secured a position as Overseer on an estate. Three boys were selected out of seventeen applicants to fill the vacancies. These seven boys continued in training up to January 1914. Two of the four boys who entered in January 1912, completed their training, the other two being retained in the Gardens for a further period. There were consequently five boys in training when the year closed.

In future a boy's training will commence in July of each year so that the time of completion of his training may coincide with the period when vacancies are most numerous on estates.

Field Work.

As in previous years since the inauguration of the present system of Agricultural Instruction every effort is made to make the work of the pupils as practical as possible and to be in keeping with the duties which they will be expected either to perform themselves, or to supervise in others, when they leave the Station to take up work on estates. They commence field work daily at 7 a.m. and continue to 4 p.m. except on Saturdays when they are given class instruction.

At the end of each day the pupils assemble in the class room to enter in their diaries an account of the day's work. Reference to these diaries shows that the boys have been engaged in the following field operations during each month of the year :—

April.—Pruning lime trees in the new Lime Experiment Plots in the valley. Opening holes for lime plants; preparing rosin compound, and spraying nurseries. Tapping Castilloa rubber trees; tarring posts for fences.

May.—Spraying citrus and ornamental plants, preparing insecticides, sowing cacao seeds, preparing bamboo pots, pruning cacao trees. Topping hedges; pollinating vanilla flowers; collecting material for mulching cacao plots.

June.—Preparing for application of manures to cacao manurial plots at the station, weighing different manures per plot, and per tree. Applying manures. Gathering seeds of green dressings; budding lemons on sour orange stocks. Pruning cacao trees; applying manures to lime experiment plots; tarring gates in experiment plots; picking cacao and removing suckers.

July.- Sowing lime seeds. Planting cuttings of shade trees; sowing seeds of green dressings through coco-nut plot. Topping hedges; applying manures; tapping Castilloa rubber trees; preparing insecticides and spraying nurseries.

August.—Lining out for planting lime plants in new Experiment Station. Spraying lime plants; transplanting lime seedlings. Picking and suckering cacao; preparing a fungicide, and applying to seedling limes. Potting cacao seedlings; spraying lime plants and transplanting lime seedlings. Preparing stock solution of rosin compound; budding lemons on sour orange stocks; applying lime to heavy land.

September.—Transplanting lime seedlings. Sowing seeds of green dressings in the nursery. Trimming hedges; spraying lime seedlings; suckering cacao; potting cacao seedlings. Preparing Bordeaux mixture; planting lemon grass on poor soil to produce mulch for experiment plots. Dressing cacao trees for 'canker'. Poisoning wood ant nests in cacao cultivation. Preparing seed boxes and sowing seeds.

October.- Potting cacao seedlings. Sowing seeds of green dressings, suckering cacao and treating wounds on cacao trees with tar. Weeding and mulching young coco-nuts. Tarring posts exposed to weather. Surveying and enclosing two new cacao manurial plots; mulching Para rubber trees; preparing bamboo pots; removing moss and other epiphytes from citrus trees. Mulching young limes planted in experiment plots Lifting and transplanting sour orange stock for budding. Tapping Castilloa rubber trees; transplanting lime seedlings.

November—Transplanting lime seedlings; sowing seeds of tangerine, mangoes, and avocado pears. Weeding borders and trimming hedges. Packing vegetable

seeds ; potting cacao seedlings. Planting hedges of Acalypha. Planting cuttings of *Gliricidia maculata*. Picking and suckering cacao ; weeding green dressing plots.

DECEMBER.—Transplanting lime seedlings ; sowings seeds of ornamental plants in boxes ; preparing stock solution of kerosene emulsion ; potting cacao seedlings. Picking cacao ; sowing lime seeds in beds ; weeding lemon grass plot ; spraying cacao for attack of thrips. Sowing cacao seeds. Poisoning wood ant nests ; sowing lime seeds.

JANUARY.—Pruning dead wood in lime trees. Suckering and picking cacao. Preparing stock solution of Kerosene Emulsion ; spraying limes and cacao. Weeding green dressing plots. Preparing seed boxes and sowing lime seeds. Tapping Castilloa rubber trees ; sowing seeds in boxes ; transplanting lime seedlings.

FEBRUARY.—Transplanting lime seedlings. Sowing lime seeds. Picking and suckering cacao. Gathering seeds of green dressings. Preparing stock solution of Rosin Compound.

MARCH.—Transplanting lime seedlings. Dusting lime seedlings with sulphur and lime. Applying manure to cacao. Spraying citrus nurseries. Sowing seeds of limes ; trimming hedges ; mulching and spraying young limes in new experiment plots. Preparing seed boxes and sowing cacao seeds. Pollinating vanilla flowers. Preparing stock solution of 'Scalo.' Pruning lime trees in the Experiment Station.

As was anticipated the addition to the Department of the new Lime Experiment Station has found the pupils much work to do which cannot fail to be of much practical value. Indeed the various branches of the work of the Department afford a keen boy an excellent opportunity for gaining experience.

CLASS WORK.

The actual class teaching is confined to Saturday morning from 8 a.m. to 12 noon. During this time the field work of the boys during the previous week is reviewed and the why and the wherefor of each operation explained. Their diaries are also corrected and initialed.

In addition the boys are taken through the syllabus as set for the Preliminary candidates in the reading courses of the Imperial Department of Agriculture.

The class teaching is followed up during the week by the entering of notes on the lessons and by setting of questions on the work done in the previous week in the field and class room. The answers to these questions are corrected and marks awarded.

EXAMINATION OF CLASS WORK.

The pupils were examined twice during the year, in July by Mr. W. R. Dunlop, Scientific Assistant to the Imperial Department of Agriculture, and in December by Mr. W. Nowell, the Mycologist of the Department.

The nature of these examinations may be best judged by giving a selection of the questions. Of the eleven questions set in the first examination the following are typical :—

'Describe in detail how you would prepare either (a) enough Kerosene Emulsion with which to treat twenty trees, or (b) enough Bordeaux Mixture for thirty trees.'

'Give an account of how you raise lime seedlings and transplant them in Dominica. How many plants are required for an acre of plantation land ?'

'Give an account of any manurial experiment you have seen carried out in Dominica. What results were obtained ?'

'From what sources does a plant obtain its food supply ? Mention in particular how it obtains its carbon and hydrogen.'

Mr. Dunlop's report on the answers to these questions is as follows :—

'Six candidates sat for the examination. The best result was obtained by H. A. Frank with 77·5 per cent. of the total marks procurable. The general standard was, on the whole, remarkably even and quite satisfactory, no boy obtaining less than 64 per cent. of the marks for the two papers set whilst the average for all candidates was 68·5 per cent. This is rather higher than that obtained in previous years.

'2. As in former examinations the answers to the practical papers were more satisfactory than those to the theoretical questions.

'3. The pupils appear to continue to receive careful instruction, but more attention might be given to the matter of diagramatic, scale drawing. With one or two exceptions the attempts at graphical explanation were decidedly weak. One or two answers indicated the lack of any ability to observe or think about natural objects not brought directly under the notice of the pupil during the course of instruction.

'4. In general, the answers evinced a sound grasp of general principles shown, for example, by the reference to the 'control' plot in the description of manurial experiments with cacao in Dominica, and the restriction of the considerations to the pistil and stamens in most of the answers to the question dealing with the essential parts of a flower. Details, as regard practical work, were given fully to some questions (e.g. that on the pollination of the vanilla flower), but to others (e.g. preparation of spraying mixtures) they were given inadequately.'

Mr. Nowell's report on the December examination is as follows :—

'Seven pupils sat for the examination of whom four are completing their training, while the remaining three commenced their training in July, 1913.'

PAPER I.—THEORETICAL.

'The first question was merely designed to test whether the pupils were alive to the importance of the presence of water vapour in varying quantities in the air. Most of them gave the constituents of the atmosphere more or less correctly, but all missed the real point of the question. The second question was answered in rather mechanical fashion but correctly.

'The third question was answered on the same lines by all who attempted it. The answers are correct so far as they go, but show little disposition on the part of the students to observe for themselves.

'Questions 4, 5 and 6 were generally well treated, and some of the answers were very good.

'The work in general shows evidence of careful teaching as distinct from mere lecturing. The similarity which is very noticeable in the answers is obviously due to the reproduction from memory of the lessons given. While instruction in general principles is probably out of the question under the circumstances, the instructor should bear in mind the importance of making use of every opportunity of encouraging the boys to reason for themselves and to develop the power of their observation.

PAPER II.—PRACTICAL.

'In dealing with question I all the pupils save one chose to describe the preparation of Bordeaux mixture. The essential points in the production of a good mixture were omitted, namely, the preliminary slacking of the lime, and the simultaneous pouring of the suspended milk of lime and the copper sulphate solution into the third vessel.

'It is essential that they should themselves assist in a demonstration of the actual preparation of the fungicides and insecticides included in the syllabus.

'The answers to questions 2 and 3 varied very widely in the amount of detail given, but all showed an acquaintance with the essentials of the operations described.

'Question 4, which might have been effectively answered in three words, was the one with which the pupils, being called upon to prescribe for a situation probably not directly dealt with in their instruction, were least at home. Four boys left the question alone. Amongst the methods advocated by the others were the burning of the plants, the burning of the caterpillars, and the use of arsenical poisons. The specialization of caterpillars to particular food plants seemed not to be appreciated.

'Question 5 was successfully answered by all the candidates.

'The work of F. J. A. Lawrence in the theoretical paper and of E B. Joseph in the practical paper is deserving of special mention. The highest aggregate in the two combined was obtained by S. F. H. Jules.

'The average percentage of marks obtained was 78.'

CADETS.

As reported in the last progress report there were two cadets in training at the year, viz, C. T. Watts and C. Winston. Cadet Watts remained in the Station up to November 11 when he left to undertake an appointment in Jamaica. Cadet Winston completed his training in December, 1913. There were no cadets being trained when the year closed. It may not be generally known in Dominica that a definite scheme for training cadets in agricultural work has been laid down on suggestions made by the Commissioner of Agriculture. The following is a brief outline of the system.

A cadet is a boy who has received some teaching in science at the Grammar School and who having completed his training there intends to adopt the planting profession. By arrangement he continues to attend classes in science at the Grammar School, the remainder of his time being spent at the Botanic Gardens.

At the Botanic Gardens the cadet assists in the ordinary routine work of the Department under the direction of the staff. He witnesses and performs all the operations as carried out by the pupils (see above). He may also if his skill and capacity permit be entrusted with duties of further responsibility such as would be performed by a Junior Assistant, for example the recording yields of experiment plots, the application of manures, certain office duties, etc.

Cadets are required to keep note books of the duties they perform and these are inspected and signed by the officer-in-charge. Periodic reports on their work are sent to their parents.

Cadets are required to enter for the Reading Courses and Examination in Practical Agriculture of the Imperial Department of Agriculture.

The status of cadets is that of Grammar School scholars; they are appointed for one year subject to extension under certain conditions.

PRIZE-HOLDINGS COMPETITION.

The following report by the Assistant Curator places on record the work done in this direction during the year under review:--

Agricultural Superintendent,

I beg to forward the following report on the working of the Cacao Prize Holdings Competition held in the Grand Bay district during 1912-13.

It will be remembered that a similar competition was held in the same district on two previous occasions, viz., during 1908-9 and last year 1911-12; also that a very successful competition was held for three consecutive years in the La Plaine District. These competitions were inaugurated by the Imperial Department of Agriculture with the object of improving the methods of cacao cultivation amongst the peasant proprietors of the different districts. Mr. J. O. Henderson, himself a successful cacao planter and much respected by the people of his district, again acted as local instructor.

As on previous occasions there were two classes of holdings :—

CLASS I for holdings not over 4 acres and not less than 1 acre of bearing cacao, and

CLASS II for holdings under 1 acre and not less than 100 trees of bearing cacao calculated at a reasonable distance apart.

In all, twenty-five entries were received, fourteen for Class I and eleven for Class II. This is nine more than in 1908-9 and one more than last year. It should be pointed out, however, that the first prize winners in previous competitions were not allowed again to compete so that altogether twenty-nine proprietors in this district have been brought under the influence of the competition and received instruction and advice.

All the holdings were visited three times during the year by the local instructor and myself. Altogether we spent eighteen working days in instructing the competitors as to how their cacao plots should be treated. We indicated what should be done, marking out trees and branches which were useless, and in several cases where drains were required we lined out their course. We also instructed them as to the method of removing pods from the trees, the danger of allowing the husks to lie about the plots, the need for manuring and wind-breaks, and the removal of the lower branches of shade trees.

The majority of the competitors were quite willing to do everything shown them with the exception of removing trees. This latter operation they only reluctantly performed on a small area as an experiment; they held the opinion that the greater the number of trees the bigger the crop produced from a given area. This was the attitude they took during 1911-12. This year they all without exception testified to the increased yields obtained from the portions treated, and by several competitors we were requested to indicate how the thinning should be done throughout the plot. The process of thinning is of necessity a gradual one and it will take several years to complete.

Of the twenty-five competitors thirteen have done very good work, especially in Class I where the competition was very keen. It was not, however, possible to award the 1st prize in full owing to the absence of any one person who could be said to be far superior to the others. The position has been met by dividing the first prize between two competitors. In the 2nd class, owing to lack of merit, the 1st prize was not awarded.

As a result of three years' work in this district the plots have much improved and form a strong contrast to the plots of the people who refused to join the competition. There remains still plenty to be done even amongst the prize winners; especially in regard to general neatness around their holdings, etc. Many of the competitors own land other than the plots entered. The principles which they have been taught will undoubtedly influence their methods of cultivation on these plots also. This is supported by the fact that former prize winners spare no effort in keeping their plots in excellent order and up to the standard we found them when they took part in the competition in former years.

The stage has been reached in this district similar to that in La Plaine where it is not necessary again to offer money prizes. Annual visits by an agricultural officer whom they now welcome will, I am of opinion, be sufficient to keep the people, whether former competitors or not, on sound agricultural lines.

An invitation has been given to the peasant proprietors of both the La Plaine and Grand Bay districts to visit the Experiment Station, and to see for themselves the advantages of adopting improved agricultural methods.

What has been achieved through these competitions in these two districts can certainly be achieved in other districts where there are a fair number of small holdings. It remains for the people themselves to move in the matter and to petition the Government for such a competition. The Agricultural Department is prepared to give all the assistance in its power.

In conclusion I would add that the Department is much indebted to Mr. Henderson for the interest he has taken in the competition. Without his assistance it could not have been successfully concluded.

A list of the prize winners is attached.

LIST OF PRIZE WINNERS.

PRIZE HOLDINGS COMPETITION, 1912-13.

CLASS I.

J. L. Angol Davis Durand	1st prize	£2 10 0
L. Polycarp B. Leathem	2nd „	2 0 0
O. Thomas Eugene Cuffy	3rd „	1 10 0
Benj. J. Lewis A. Celestin	4th „	12 6

CLASS II.

Matthew	2nd prize	£1 5 0
M. Liverpool	3rd „	15 0
J. Leathem	4th „	10 0
Walter Blanc		10 0
R. Ferdinand		10 0

COURSES OF READING AND EXAMINATIONS IN PRACTICAL KNOWLEDGE.

Courses of reading have been organized under the direction of the Imperial Department of Agriculture for the purpose of enabling overseers and others engaged in agriculture to acquire from reading, knowledge that they can apply in connexion with their practical work.

Examinations are held annually, usually during October and November, for which persons who have been previously registered as students for the courses of reading may become candidates. There are three examinations, viz., Preliminary, Intermediate and Final. Certificates are awarded to the successful candidates on passing each examination.

The Preliminary Examination requires a general all-round knowledge of the elementary principles of agriculture. The Intermediate and Final Examinations may only be taken after the candidate has had several years experience on an estate. The man who possesses the three certificates may be guaranteed as having a sound knowledge of the principles of agriculture, and also a practical knowledge of at least two crop subjects.

Previous to the year under review, four candidates from Dominica had been successful in the preliminary examination and one of these had been awarded an intermediate certificate.

The examination which was held last November was sat by three candidates—one Final and two Intermediates. Only one of the three was successful and he has been awarded a 2nd class Intermediate Certificate.

These young men, who work under considerable disadvantages, are to be congratulated on their efforts and deserve every encouragement, and it is only to be regretted that others similarly situated do not take advantage of this excellent opportunity of self-improvement offered them.

Any intending candidate may attend the classes given to the pupils of the Department on Saturday mornings, on application being made. Those who cannot attend may send to the Botanic Station written answers to the questions appearing in the Students' Corner columns in the *Agricultural News* and have them corrected and returned.

G. A. JONES.

Assistant Curator,
Botanic Gardens.

SCIENCE TEACHING AT THE GRAMMAR SCHOOL, DOMINICA, 1913-14.

The number of boys who attended the school and the number of boys who joined the Science Class during the six terms named are shown by the following figures from which it will be observed that usually about half the pupils upon the roll of the school avail themselves of the science teaching offered.

	No. of boys who attended the school.	No. of boys who joined the Science Class.	
Summer Term 1912. ...	29	16	Upper Division 8 Lower Division 8
Michaelmas Term 1912 ...	31	18	Upper Division 7 Lower Division 11
Lent Term 1913	30	16	Upper Division 6 Lower Division 10
Summer Term 1913 ...	31	16	Upper Division 4 Lower Division 12
Michaelmas Term 1913 ...	35	16	Upper Division 3 Lower Division 13
Lent Term 1914	39	19	Division I 2 Division II 8 Division III 9

2. The increase in numbers and the general progress of the boys rendered it imperative to divide further the Class at the commencement of the Lent Term 1914, thus making three distinct divisions of boys.

The instruction received by each division was as follows :—Division 1 practically followed the course laid down by the Cambridge Local Examination Syndicate for the Junior Examination. Division II practically followed the requirements of the Cambridge Local Examination Syndicate for the Preliminary Examination.

Division III. This division was formed of boys who were backward and those who had newly joined the Class, so that the instruction given was, therefore, of a very elementary character.

3. Eight periods, each three-quarters of an hour in duration, were devoted to science per week : four to Chemistry and four to Botany. Thus the actual amount of science teaching received by each division was reduced to two hours per week. So limited was the time, and as there was no way of remedying this, there arose the doubt as to whether the courses for the Cambridge Local Examination to be held in the coming December could be satisfactorily covered.

In the case of the boys of Forms II and I who belong to Division III of the Science Class, an extra period of three-quarters of an hour was given on Tuesday mornings, while the remaining boys of the two forms were, at the same time, instructed by the Science Master in another subject.

4. The three divisions were present at the same time in the class room during the science lessons. The difficulties arising from this fact were similar to, but more pronounced than those stated in the report for the year 1912-13, in consequence of the further subdivision of the class and the shorter time necessarily alloted to actual teaching.

5. Practical chemistry was taken twice a week with the boys of Division I and the top three boys of Division II. It is to be regretted that the lack of sufficient apparatus and chemicals made it impossible for the whole of Division II to receive instruction in Practical Chemistry.

This work was carried on at the close of school from 3 to 5 p.m. (the length of time depending on the work to be done) as no time during school hours was available. Considerable progress has been made both by the pupils, who have been keenly interested in the work, and in regard to the fittings and general equipment of the laboratory in so far as the small annual vote for upkeep would allow.

6. Instruction in Practical Botany is at present confined to the germination and subsequent development of typical seeds and to experiments to illustrate the different botanical phenomena. The boys are trained to draw correct conclusions for themselves and to write an account and make sketches of each experiment.

Many thanks are due to A. H. Green, Esq., of Canefield estate, who during the Summer vacation of 1913, very kindly presented a microscope to the school. Although the instrument is of an old pattern, it nevertheless has proved a valuable aid to the teaching of plant Histology in connexion with which a microscope was badly needed.

7. In the Cambridge Local Examination held in December 1913, two boys were presented for a Preliminary Chemistry and two for Preliminary Botany. The result of the examination showed that all were successful.

8. In view of an Agricultural Class, which may be expected to be arranged in the near future, an addition to the school library of a few standard works on Agriculture and the allied sciences would be a great acquisition. The existing library contains chiefly books of fiction, and none of any scientific value whatever from an agricultural standpoint. If a small number of good works on agricultural subjects could be obtained each year, in course of time a useful reference library would be formed.

H. WATERLAND,

Agricultural and Science Master.

Work in Cacao Experiment Plots.

MANURIAL TRIALS.

The customary review of the results attained in the manurial experiments with cacao conducted by the Agricultural Department in Dominica is given in the following pages.

The manurial trials with cacao carried on in the Botanic Station, Dominica, comprise three series of experiments, which for purposes of reference are denoted as follows :—

1. The original series of experiments.
2. The ¼-acre plots, which form an adjunct and extension of the original series.
3. The hillside plots designed to test how far the manurial applications found to give good results on flat land, are applicable to cacao planted on steeply sloping hillsides.

The practice has been followed in former reports of reviewing these three series of experiments separately and this plan is again adopted on the present occasion.

Original Series of Experiments.

These plots are situated on level land adjoining the office buildings of the Dominica Botanic Station. The nature of these experiments has been fully described in previous reports, but for convenience of reference, the following description is again reproduced.

The plots occupy approximately 1½ acres of level ground, and were originally laid out in the year 1900 at which time the land was planted in bearing cacao about ten years old. Since the year 1902-3, similar treatment has been accorded to each individual plot in every succeeding year, so that at the present time the condition of each plot represents the accumulated result of twelve years continuous manurial treatment on the same lines.

The series of experiments are five in number, and the manurial treatment accorded to each, and other details connected with the experiments, are given in the following statement reproduced from the previous report.

The following table shows the number of trees now in each plot, the number of trees originally present when the experiment was first laid out, the area of each plot and the manurial treatment received :—

No.	Letter on station plan.	No. of bearing trees per plot.		Area of plot in acres.	Present number of trees per acre.	Manurial treatment.
		In 1900.	In 1914.			
1	C	34	51	0·28	182	No manure.
2	A	37	64	0·29	221	Basic phosphate, 4 cwt. per acre. Sulphate of potash, 1½ cwt. per acre.
3	B	40	59	0·36	164	Dried blood, 4 cwt. per acre.
4	E	34	44	0·29	152	Basic phosphate, 4 cwt. per acre. Sulphate of potash, 1½ cwt. per acre. Dried blood, 4 cwt. per acre.
5	D	39	49	0·37	132	Mulched with grass and leaves.

A few years ago, the plan was adopted of planting on each plot a sufficient number of trees to cover the ground, and the figures given represent the number of bearing trees in each plot at the present time. In the control plot, a number of trees have recently died out, and seven young trees have been planted to take their places. The continued fluctuation in the number of trees renders the figures for the yield per tree very uncertain and this has in consequence been omitted from the results for the season now under review.

The plots have received the same manurial dressings as in previous years. The artificial manures are distributed over the surface of the ground and lightly raked in. The material of which the mulch is composed consists chiefly of grass from the lawns, and leaves and pods of the saman tree (*Pithecolobium Saman*) surrounding the lawns. The manures and the mulch on each are applied once a year. The mulch is applied at the rate of 5 tons per acre. It may be added that the presence of the Saman pods in the material used for mulching, results in a dressing somewhat richer in nitrogen than would otherwise have been the case.

No forking has been performed in any of the plots since the inception of the experiments; the only cultural operations undertaken beyond the application of the manures being the usual ones connected with the pruning of trees and sanitation of the orchard.

The yields of cacao recorded each year are for periods of twelve months terminating on June 30. This date is chosen because there is no cacao being gathered at that time. Other dates possess the disadvantage that, owing to the fluctuations in the spring or carême crop, it may happen that two such crops are included in one year—a late crop of one year, and an early crop of the succeeding year; while on other occasions there may be no carême crop in the year under review. Such fluctuations disturb and confuse the records, hence the results are made to refer to the crop year extending from July 1 to June 30. This mode of reckoning is recommended for adoption as a basis of records in connexion with West Indian cacao crops.

The annual rainfall for each year since the inception of the experiments is given below. In accordance with the matter in the previous paragraph, the figures are given for twelve months commencing on July 1 of one year and ending on June 30 of the next:—

Period.	Year.	Inches.
Twelve months ending June 30, ...	1903	72·46
,, ,, ,, ,, ...	1904	93·02
,, ,, ,, ,, ...	1905	70 13
,, ,, ,, ,, ...	1906	74·60
,, ,, ,, ,, ...	1907	69·02
,, ,, ,, ,, ...	1908	67·08
,, ,, ,, ,, ...	1909	69·47
,, ,, ,, ,, ...	1910	94·90
,, ,, ,, ,, ...	1911	89·71
,, ,, ,, ,, ...	1912	80·54
,, ,, ,, ,, ...	1913	64·76
,, ,, ,, ,, ..	1914	71·60

The following table shows the yields in the year under review, together with those from the plots in each year since the systematic record of the returns was first undertaken. The yields of the past year are shown in the bottom line of the table. This method enables the progress of each of the plots to be seen at a glance. The yields are given in terms of wet cacao per plot and pounds per acre, and cured cacao, pounds per acre. In calculating the yield of cured cacao per acre, the assumption is made that 100 ℔. of wet cacao will yield 42 ℔. of cured cacao.

Year.	Plot 1. No manure.		Plot 2. Phosphate and potash		Plot 3. Dried blood.		Plot 4. Dried blood, phosphate and potash.		Plot 5. Mulched with grass and leaves.	
	Per plot	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.	Per plot.	Per acre.
1902-3.										
Wet cacao ..	759	2,711	1,063	3,666	1,281	3,558	1,104	3,807	1,145	3,095
Cured cacao ..	...	1,138	...	1,510	...	1,491	...	1,599	...	1,300
1903-4.										
Wet cacao ..	548	1,956	808	2,786	970	2,694	738	2,545	962	2,600
Cured cacao ..	...	822	..	1,170	...	1,131	...	1,069	..	1,092
1904-5.										
Wet cacao ..	673	2,403	814	2,801	970	2,694	979	3,376	1,279	3,457
Cured cacao ..	..	1,009	..	1,179	..	1,131	...	1,418	...	1,450
1905-6.										
Wet cacao ..	748	2,672	763	2,631	1 056	2,933	1,040	3,586	1,519	4,105
Cured cacao ...	..	1,122	...	1,105	..	1,252	...	1,506	...	1,724
1906 7.										
Wet cacao ...	730	2,607	887	3,059	972	2,700	1,009	3,479	1,536	4,151
Cured cacao ...	...	1,095	...	1,285	...	1,131	..	1,161	...	1,743
1907-8.										
Wet cacao ...	903	3,225	1,160	4,000	1,381	3,836	1,180	4,069	1,773	4,792
Cured cacao ...	...	1,551	...	1,689	...	1,611	...	1,709	...	2,012
1908-9.										
Wet cacao ...	978	3,492	1,205	4,155	1,377	3,825	1,344	4,634	1,777	4,803
Cured cacao ...	..	1,467	...	1,745	..	1,607	..	1,946	...	2,017
1909-10.										
Wet cacao ...	848	3,029	963	3,321	1,167	3,241	1,267	1,369	1,822	4,924
Cured cacao ...	...	1,272	...	1,395	...	1,361	...	1,835	...	2,068
1910-11.										
Wet cacao ...	859	3,067	1,097	3,783	1,289	3,581	1,297	4,473	1,890	5,107
Cured cacao ...	...	1,288	..	1,589	...	1,504	..	1,879	...	2,145
1911-12.										
Wet cacao ...	804	2,871	1,012	3,490	1,272	3,533	1,272	4,387	1,721	4,651
Cured cacao ..	...	1,206	...	1,466	...	1,484	...	1,842	..	1,953
1912-13.										
Wet cacao ...	892	3,186	1,088	3,752	1,512	4,200	1,314	4,531	2,001	5,408
Cured cacao ...	...	1,338	...	1,576	...	1,764	...	1,903	...	2,271
1913-14.										
Wet cacao ...	678	2,422	885	3,050	1,133	3,147	1,104	3,807	1,509	4,078
Cured cacao ...	...	1,017	...	1,281	...	1,322	...	1,599	...	1,713

The following supplementary table gives the average return of wet and cured cacao in pounds, for twelve years.

No.	Plot.	Wet cacao,		Cured cacao,
		per plot.	per acre.	per acre.
1	No manure	785	2,804	1,178
2	Phosphate and potash	979	3,376	1,418
3	Dried blood	1,201	3,336	1,401
4	Dried blood, phosphate and potash	1,137	3,921	1,647
5	Mulched with grass and leaves	1,578	4,265	1,791

The pecuniary aspect of the experiments is dealt with in the two following tables, in which are shown the gains from the application of the different manures, both for the year under review, and for the average return for the entire period during which the experiments have been conducted. In calculating the monetary gains, the value of cured cacao has, as in previous reports, been assumed at 6*d.* per lb.

The following table shows the average monetary gain from manuring during twelve years.

Plot.	Average annual yield of cured cacao per acre during twelve years.	Gain in cured cacao per acre over No manure.	Value per acre of increase over No manure at 6*d.* per lb. of cured cacao.	Cost of manuring per acre.	Gain per acre by manuring.
	lb.	lb.	s. d.	s. d.	s. d.
1	1,178	..	..	..	...
2	1,418	240	120 0	45 3	74 9
3	1,401	223	111 6	52 0	59 6
4	1,647	469	234 6	97 3	137 3
5	1,791	613	306 6	80 0	226 6

The monetary gains from manuring during the year 1913-14 may be shown as follows:—

Plot.	Yield per acre of cured cacao 1913-14.	Gain per acre over No manure.	Value per acre of increase over No manure at 6*d.* per lb. of cured cacao.	Cost of manuring per acre.	Gain per acre by manuring.
	lb.	lb.	s. d.	s. d.	s. d.
1	1,017	..	...	...	...
2	1,281	264	132 0	45 3	86 9
3	1,322	305	152 6	52 0	100 6
4	1,599	582	291 0	97 3	193 9
5	1,713	896	448 0	80 0	368 0

In calculating the monetary gains resulting from the application of the various manures, the cost of applying the mulch to plot 5 has been assumed at 80s. per acre. This is an increase of 20s. on the figure given in previous years and is intended to cover the increase in the cost of labour which has risen considerably of late years. In practice at the Botanic Station, it is considerably less than this, since the collection of fallen leaves from the lawns constitutes a part of the ordinary routine in the care of the grounds. It is estimated, however, that a mulch of the size indicated could be obtained from the surrounding bush and applied under the conditions obtaining on a cacao estate in Dominica for the sum mentioned.

During the year under review there has been a very considerable decline in the yields of all the five plots. This falling off in the cacao crop has been very general throughout the island and is difficult to account for. The rainfall and other general climatic condi ions were normal. Of the five plots, Nos. 1, 3 and 5 suffered most, recording a drop of 25 per cent. over the previous year's returns. Nos. 2 and 4 fell off 18 7 and 16 per cent. respectively. It will be noticed that plots 2 and 4 both receive basic slag, while 1, 3 and 5 do not. In this connexion Mr. Tempany in his report on these plots last year offered the following suggestion.—

In view of the small lime content of the soils of these plots it seems possible that the presence of the constituent in the dressing of basic slag supplied to plot 4 (and 2) may assist to maintain nitrification at a more even rate and so tend to bring about a more equable condition of fertility'. This year's results tend to support this explanation. Some variation in yield from year to year is to be expected. Especially is it natural for a somewhat light crop to follow a heavy one as was experienced on these plots in 1912-13.

The mulch plot continues to give the maximum return and its general appearance is such as to place this method of manuring in the front rank. The trees continue healthy and vigorous and form a striking contrast to the adjoining control plot.

A detailed study of the condition of each plot was made during 1913-14, and an account of these investigations published in the *West Indian Bulletin*, Vol. XIV, page 81.

It should be emphasized that the present method of manuring was commenced twelve years ago, and that the plots have received identical treatment each year since. It is of the greatest importance that the experiments should continue on the same lines without interruption. In support of this it may be stated that results based on four, six, or even twelve years' treatment are not always reliable, e.g. reference to the table giving the average return for wet and cured cacao for twelve years would make it appear that over this considerable period plot 2 receiving basic slag and sulphate of patash is in a more flourishing condition than plot 3 receiving dried blood only, and that the former method of manuring is superior to the latter. This conclusion however, is erroneous as of late years the yield from the dried blood plot has been greater than that of plot 2, and further the appearance of the trees on the plot receiving dried blood is much more satisfactory than that on the phosphate—potash plot which is now showing marked signs of nitrogen starvation.

Quarter acre Plots.

This series of experiments was laid out in 1907 as an adjunct of the original series. It comprised two plots $\frac{1}{4}$ acre in extent denoted one station plan by the letters F and G respectively; they are situated on level ground almost adjacent to plots A, B, C, D and E and the conditions are practically identical with those of the older series of experiments. The following account of the origin of these plots is reproduced from the report for 1911—12:—

'The origin of these plots was described in the Report on the Botanic Station and Experiment Plots, Dominica, for 1909-10, p. 27, and to this readers are referred for further information. For convenience of reference it may here be stated that the plots were inaugurated some eighteen years ago with the object of ascertaining whether Criollo cacao could be satisfactorily grown in Dominica. Plot G was first established, plot F being planted some three years after. As a result it was found that this variety was not suited to conditions in Dominica, the trees being attacked by canker when between the ages of seven and twelve years. In

consequence of this, the original Criollo trees have gradually died out, and as they died it has been customary to replace them with a hardier variety. In Plot G at the present time the whole of the Criollo cacao has died out, and been replaced; plot F being younger, still contains some Criollo trees which are now dying out, and being replaced. In 1907 it was decided to devote these two ¼—acre plots of cacao to additional manurial experiments. The manurial treatment accorded to each plot and the number of bearing trees at present contained in them are as follows:—

Plot F. Mulched with grass and leaves at the rate of 4 tons per acre. Number of trees in plot, fifty-three; of which forty-nine are in bearing and six not in bearing.

Plot G. Manured with cotton seed meal at the rate of 600 lb. per acre. Number of trees in plot, fifty-three; of which fifty are in bearing and three not in bearing.

The returns from these plots in lb. of wet cacao per plot and per acre, and in cured cacao per acre, for each of the seven years during which the experiments have been carried on are given in the following table:—

Year.	Plot F. Mulched with grass and leaves.			Plot G. Manured with cotton seed meal.		
	Wet cacao, lb. per plot.	Wet cacao, lb. per acre.	Cured cacao lb per acre.	Wet cacao, lb. per plot.	Wet cacao, lb. per acre.	Cured cacao lb. per acre.
1907-8	881	3,524	1,480	1,019	4,076	1,712
1908-9	1,119	4,476	1,880	1,060	4,240	1,781
1909-10	1,242	4,969	2,087	1,039	4,156	1,746
1910-11	1,225	4,900	2,058	1,006	4,024	1,690
1911-12	1,070	4,280	1,798	923	3,692	1,549
1912-13	1,377	5,508	2,313	1,207	4,828	2,028
1913-14	1,300	5,200	2,184	924	3,696	1,552

The mean results from these plots for the seven years during which the experiments have been conducted, in terms of wet and cured cacao are as follows:—

Plot.	Wet cacao lb. per plot	Wet cacao lb per acre.	Cured cacao lb. per acre.	Difference on No Manure, Plot C. for seven years in cured cacao lb. per acre.
F. Mulched with grass and leaves ...	1,173	4,692	1,971	+693
G. Manured with cotton seed meal ...	1,025	4,100	1,722	+444

From the first of the above tables it will be observed that the cotton seed meal plot suffered a similar check to the plots of the older series of experiments and a decline of 23 per cent. is recorded. The mulched plot however, had only a slight falling off of 5·6 per cent.

A glance at these two tables gives additional evidence of the superiority of the mulching method and this system of manuring has produced on Plot F. an average increase of 693 lb of cured cacao per acre over a period of seven years when compared with the yield obtained from the No manure plot C. Calculated on the same basis the dressing of cotton seed meal has produced an average annual

increase of 444 lb of cured cacao per acre. It is quite probable that a heavier dressing of cotton seed meal would produce even better results, as the quantity of nitrogen supplied per acre, with a dressing of 600 lb., is considerably less than is applied to the mulched plots and those obtaining dried blood.

At the present prices a dressing of 10 cwt. of cotton seed meal per acre would cost about £2 10s. 0*d.*

Hillside Plots.

These plots are laid out on matured cacao trees growing on a steeply sloping hillside within the Botanic Gardens, and are adjacent to one another.

Much of the cacao at present grown in Dominica is planted on the sloping sides of valleys and the experiments were designed to test the value of the mulching method under these conditions.

The experiment comprises two plots designated H and I on the plan of the Station, plot H has received no manure while plot I has been mulched with grass and leaves in similar fashion to plots D and F. The mulch in this case however, has consisted almost entirely of the fallen leaves of the Mahogany tree (*Swietenia Mahagoni*), thus avoiding the high nitrogen content of the saman leaves and pods used in plots C. and F. In the present year the mahogany leaves have been used exclusively, and a dressing at the rate of 5 tons per acre given.

The experiment was originally laid out in 1907 and has been continued without interruption since that time.

The area of these plots was re-determined in 1911, by survey, and found to be as follows:—

Plot H.	Surface area	0·465 acre
	Horizontal area	0·414 „
Plot I.	Surface area	0·425 „
	Horizontal area	0·373 „

The returns have been calculated on the horizontal area on the plots; this forms a basis of comparison more nearly in accord with that of former years; moreover it must be remembered that the number of trees capable of being accommodated on a sloping hillside is less than can be grown on a piece of level and on the same surface area, since the tendency of the stems of the trees to grow vertically upwards necessitates that they should be planted further apart upon lines running down the hill, to allow of complete lateral development.

The following table gives the results from these two plots, calculated on the basis of wet cacao per plot and per acre, and also in pounds of cured cacao per acre, for the seven years during which the experiments have been in progress:—

Year.	Plot H. No. Manure.			Plot I Mulched with grass and leaves.			Difference on No manure in cured cacao, lb. per acre.
	Wet cacao lb. per plot.	Wet cacao lb. per acre.	Cured cacao lb. per acre.	Wet cacao lb. per plot.	Wet cacao lb. per plot.	Cured cacao lb. per acre.	
1907-8 ...	882	2,130	895	1,053	2,823	1,186	+291
1908-9 ...	957	2,311	971	1,214	3,255	1,367	+396
1909-10 ...	965	2,331	979	1,352	3,625	1,523	+544
1910-11 ...	977	2,360	991	1,897	5,086	2,136	+1,145
1911-12 ...	924	2,232	937	1,669	4,476	1,879	+942
1912-13 ...	845	2,041	857	1,674	4,487	1,885	+1,028
1913-14 ...	767	1,853	778	1,548	4,150	1,743	+965

The mean results from these plots for the seven years during which the experiments have been conducted, in terms of wet and cured cacao, are as follows :—

Plot.	Wet cacao ℔. per plot.	Wet cacao ℔. per acre.	Cured cacao ℔. per acre.	Difference on No manure in cured cacao, ℔. per acre.
H. No manure ...	902	2,178	915	
I. Mulched with grass and leaves ...	1,487	3,987	1,674	759

There has been a falling off in both these plots during the year amounting to 9·2 per cent. in the case of the control plot and 7·5 per cent. in the mulched plot over the yields of the previous year.

The mulched plot continues to yield far in advance of the No manure plot and the appearance of the trees in these two plots form a striking contrast in favour of the mulched plot.

The average of seven years continuous trials shows that the application of this form of manuring has produced a mean increase of yield amounting to 759 ℔. of cured cacao per acre. For the year under review the corresponding increase amounts to 965 ℔. of cured cacao per acre.

The three plots in the Botanic Station that are treated by the addition of a dressing of grass and leaves show beyond doubt the great benefit which follows to cacao orchards by the application of this form of manuring. They have further shown that organic manures such as cotton seed meal and dried blood combined with basic slag may be very profitably applied.

Additional Manurial Plots Laid Out in 1913-14.

Two additional plots designated K. and L. were marked out early in the year under review and the yields recorded during the crop season. To one of these an application of mulch consisting of fallen leaves (avoiding those of the saman) has been given at the rate of $2\frac{1}{2}$ tons per acre per annum, half the quantity given to plot I. with which, owing to its situation on a steep hillside it may be compared. In addition to the mulch the plot is to receive an annual application of lime at the rate of 5 cwt. per acre.

It is hoped that this plot may throw some additional light on the question of the minimum amount of mulch required per acre to produce satisfactory results also what effect small applications of lime may have on Dominica soils which are known to be so deficient in this constituent.

Plot L has recently received an application of calcium cyanamide (nitrolim) at at the rate of $2\frac{1}{2}$ cwt. per acre and it is intended to continue this treatment each year.

GRAFTED CACAO.

The following table gives the results of the observations to June 30, 1914, in respect of the grafted cacao plots.

Date of planting.	No. of trees planted.	Last date of picking.	No. of bearing trees.	Total annual yield in pods.	Yield per tree in pods.
No. 1.					
July 1906 ...	14	June 30, 1908	14	12	0·8
„ 1907 ...	14	„ 1909	14	237	16·9
		„ 1910	28	860	30·7
		„ 1911	28	1,382	49·3
		„ 1912	28	1,365	48·7
		„ 1913	28	1,274	45·5
		„ 1914	28	2,360	84·3
No. 2.					
July 1907 ...	35	June 30, 1910	35	191	5·4
„ 1908 ...	17	„ 1911	52	893	17·1
		„ 1912	52	3,466	66·6
		„ 1913	52	6,466	124·3
		„ 1914	52	7,782	149·6

Plot No. 1 consists of twenty-eight cacao trees, fourteen of which are of a Criollo variety and fourteen of a Forastero type, planted amongst established seedling orange trees, the latter being spaced at 20 feet apart. Under these conditions the table shows that the cacao crop reached its maximum during 1911, after which the health of the trees began to suffer and the crop to fall away, thus showing how quickly cacao plants suffer when placed in competition with a vigorous tree like the orange.

Towards the end of 1912, the orange trees were thinned out and during 1913 the remaining trees were removed. Improvement in the appearance of the cacao trees and in crop returns quickly followed.

Plot No. 2 consists of fifty-two trees of a free bearing Forastero type, planted at 12 feet × 12 feet, thirty-five of which were planted in July 1907 and seventeen in July 1908. During the past three years the trees have borne heavily. The manurial treatment has consisted of a light application of mulch annually, chiefly straw, carted from yards in Roseau. During the past year, several of the trees showed signs of ill health due to over bearing. It will now be necessary, if good crops are to be maintained, to apply a heavier dressing of manure to this plot.

CROPS AT THE GARDENS.

The cacao crop for the year ended June 30, 1914, was 74½ cwt., a decrease of 14 cwt. when compared with that of the previous period. This falling off was due to the partial failure of the carême crop, a condition which appeared to have been general on cacao plantations throughout the island. Details are given below :—

Shipped to London 38 bags cacao,	8,321 lb.
Cacao pods (300) used for seed at the Station, equal to	24 „
Total	8,345 lb.

Thus the yield of the cacao cultivation, which is estimated at 7½ acres, was 8,345 lb. equivalent to 41¾ bags of a standard weight of 200 lb. each. The average net weight of each of the thirty-eight bags shipped was 219 lb.

The crops gathered for the past five years are as follows.—

Year ended June,	1910	...	...	74¾ cwts.
„ „ „	1911	...	...	90¼ „
„ „ „	1912	...	...	81½ „
„ „ „	1913	...	...	88½ „
„ „ „	1914	...	...	74½ „

The rainfall for the year ended June 30, 1914, was 71·60 inches.

Other crops gathered and shipped to London were nutmegs, 515 lb. and kola nuts, 437 lb.

There were also sold locally 78 barrels of limes, 18 barrels of lemons, and fruits of oranges, tangerines, and grape fruits to the number of 55,000.

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